THE
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REVIEW

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Walking Training of the Amputee: Some Biomechanical Considerations*

Signe Brunnstrom

Effective walking training of the amputee requires on the part of the instructor a knowledge of the fundamental anatomical and mechanical principles underlying normal locomotion in man and a recognition of the possibilities and limitations inherent in the use of a prosthesis.

Scientific data on the subject are still missing or incomplete. Therefore, the approach to the problem of gait training of the amputee at this time must necessarily be an empirical one. The discussion which follows is based partly on general principles of body mechanics, partly on clinical observations and practical experience gained during more than two and one-half years' of work with amputees at the U.S. Naval Hospital, Mare Island, California.

No attempt is being made to evaluate the relative merits and shortcomings of different constructions of artificial legs. This paper is concerned primarily with the principles underlying the training of the leg amputee. The preprosthetic training was discussed in a previous paper.[1] This paper will deal with problems of balance and walking of the amputee. It will be limited to a discussion of gait of the above-knee amputee which offers a specific challenge to the instructor.

It is evident that the subject of prosthesis is an integral part of the problem and that construction and fitting of the prosthesis fundamentally affect the gait. It is not necessary or possible for the instructor to be an expert on artificial limbs, but he or she must know the principles underlying their construction and should attempt to correlate fitting of prosthesis and alignment of joints with the clinical picture. It is greatly recommended that the walking instructor have frequent conferences with the limbmaker to discuss individual cases.

The problem of dynamic balance during gait, involving motion of the body as a whole and of its individual parts in relation to each other, with inertia, speed and acceleration entering in, both in the normal individual and in the amputee, is a very complex one. Since dynamic balance is based on static balance it is appropriate to study the static balance of the amputee first, and in particular the one-legged standing position. The two questions which primarily interest us in this connection may briefly be stated as follows:

1. How may the amputee when bearing weight on his prosthesis gain anteroposterior balance?
2. How may he gain lateral balance?

Anteroposterior Balance

It has been pointed out by Mommsen[2] and others that the easy standing position in the normal individual is one which combines security with economy of muscular energy, and that such a position automatically will be assumed by most individuals. As a general rule it may be stated that economy of muscular energy is obtained when a plumbline through the center of gravity of the part above a weight-bearing joint

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(NOTE: The opinions expressed in this article are those of the writer personally and are in no way the official expression of the Medical Department of the U. S. Navy.)

falls through the center of motion of that joint. The muscles guarding that joint are in a state of readiness, coming into action to reestablish balance when balance is lost, but there is no continuous contraction of any group. In the subjects analyzed by Mommsen this held true at the hip joint: a plumbline through the center of gravity of the suprafemoral mass fell exactly through the center of the hip joint.

The rule, however, Mommsen found, did not apply to the ankle joint and to the knee joint, the reason being that here the principle of security demanded otherwise. A plumbline through the suprapedal center of gravity fell considerably in front of the ankle joint, bisecting a line between the tip of the big toe and the heel. In other words, it fell in the center of the base of support, thus giving maximum security to the body as a whole, but setting up a rotary force at the ankle joint in the sense of the body toppling over forward, which force had to be met by muscular effort (calf muscles). The supratibial center of gravity was located considerably anteriorly to the axis of the knee joint, eliminating the necessity of quadriceps action in standing, the knee being kept in extension by the force of gravity.

Mommsen found that his subjects both when standing on two feet and in the one-legged standing position, if required to maintain such position for a while, shifted the suprafemoral center of gravity slightly posteriorly to the hip joint causing a rotary force at this joint in direction of extension and hyperextension. The tension set up in the anterior ligaments of the hip joint prevented hyperextension and both flexors and extensors were relieved of their balancing action. A plumbline through the suprapedal center of gravity still fell through the center of support on the ground, giving maximum security for the body as a whole. Knee stability was not interfered with since the axis of the knee joint remained behind a plumbline through the supratibial mass (Fig. 1). As far as muscle effort is concerned this position is more economical than the alert standing position, but the body is less ready for action.

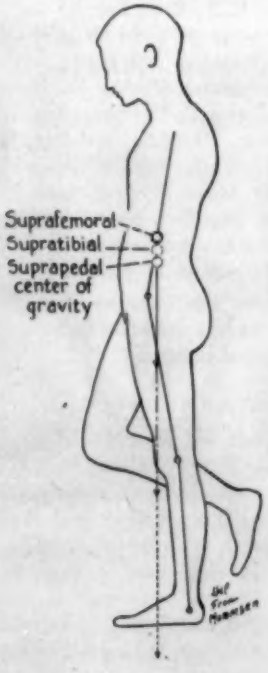

Figure 1. One-legged standing position requiring a minimum amount of muscular effort. Plumbline through center of gravity of one-sided suprafemoral mass falls posteriorly to the hip joint. Plumbline through center of gravity of one-sided supratibial mass falls anteriorly to the knee joint. Plumbline through center of gravity of one-sided suprapedal mass bisects the distance between the tip of the big toe and the heel. (Redrawn from Mommsen.)

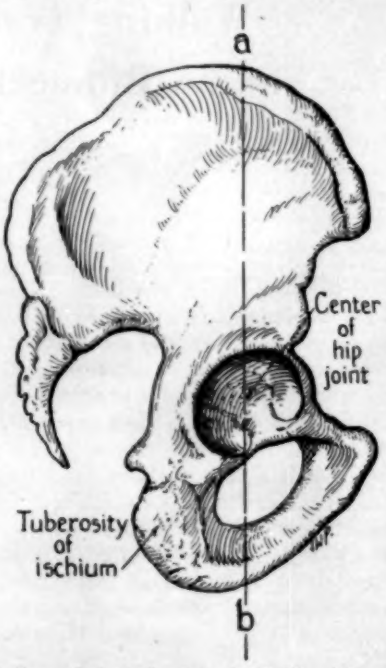

Figure 2. Lateral view of pelvis. (a-b) Plumbline through center of hip joint.

In the above-knee end-bearing type of amputation (Stokes-Gritti) very little if any postural deviations from the normal need to occur. With weight bearing through the head and the shaft of the femur, with the balancing action of hip flexors and hip extensors hardly interfered with, with no necessity for quadriceps action, the only missing force for normal anteroposterior balance is that of the calf muscles, which prevents a forward falling of the body at the ankle joint. A blocking of dorsiflexion of the foot by means of a firm front bumper provides the necessary stability.

The prosthesis for above-knee amputations built for ischial weight bearing makes it necessary for the wearer to change the alignment of his parts. During the swinging phase the stump rotates around the hip joint while the prosthesis is swinging around the trochanteric joint. Most limbmakers are careful to place the trochanteric joint in such a manner that it is in line with the center of motion of the hip joint. Because of the normal anterior torsion of the head and the neck of the femur in relation to its shaft, the trochanteric joint is placed slightly anteriorly to the tip of the greater trochanter. Thus, during the swinging phase harmony between the motion of the stump and the prosthesis is obtained. However, during the weight-bearing phase the pelvis balances on the ischial seat of the prosthesis, a point which lies considerably posteriorly to the trochanteric joint (Fig. 2). This obviously creates a certain discord. Theoretically, the ideal trochanteric joint would be one which during the swinging phase was in line with the center of the hip joint but which during the supporting phase moved backward and downward to be in line with the tuberosity of the ischium. Such a point, for obvious reasons, is not feasible.

As stated above, the normal location of the center of gravity of the suprafemoral mass during "alert" standing lies in vertical alignment with the hip joint, during "easy" standing slightly posteriorly to it. In both instances this point lies anteriorly to the tuberosity of the ischium. The force of gravity acting through the center of gravity therefore tends to tip the pelvis forward during weight bearing, upsetting the labile balance of the pelvis. The amputee automatically attempts to compensate by shifting the trunk backward in order to bring the center of gravity over the ischial seat. Two tendencies of the amputee, (a) to "sit back" on the ischial seat and (b) to walk with a lumbar lordosis, are thus explained. The former adjustment, that is, to bring the supraischial mass over its point of support without an increase in the lumbar curve, obviously is the more desirable one. It can be accomplished only if the stump has complete range of motion in extension. The latter adjustment occurs if range of motion of hip extension is incomplete, in which case the pelvis remains tilted forward and the patient has to compensate higher up by throwing the head and the shoulders backward (Fig. 3).

The above-knee amputee, to maintain correct pelvic balance, should actually be able to extend the thigh a few degrees more than is required by the normal individual, since in the amputee the surface of support, the foot, has to be brought in vertical alignment with the tuberosity of the ischium instead of with the hip joint. Because most individuals, even with extensive training are unable to obtain true hyperextension at the hip, it may be advisable to set the stump in a slightly flexed position in the bucket. Only a few degrees of flexion are necessary to allow complete mechanical extension of the prosthesis in relation to the pelvis. It also has been pointed out that the tuberosity has a better weight-bearing surface when the thigh is slightly flexed. (In the hyperextended position the tuberosity is more deeply imbedded in muscles.)

With a slight hip flexion contracture present the patient may by proper walking practice overcome the condition, but if the contracture is marked the subject does not succeed in doing so, since walking causes too much strain in the lumbar region without putting enough stretch on the structures anteriorly to the hip joint. For such a subject intensive treatment for the elimination

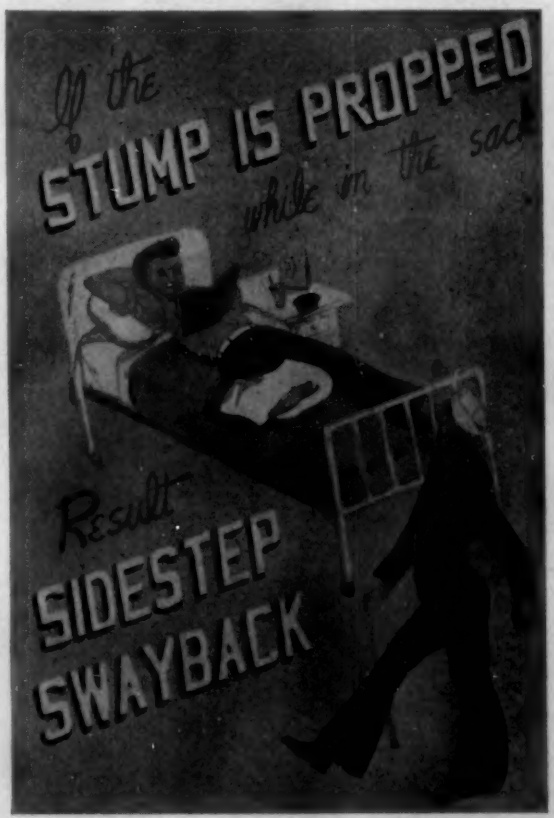

Figure 3. Poster placed on amputation wards reminding patients and personnel of the importance of correct bed posture. (Drawn by Rosemary MacBird.)

of the contracture must be instituted and he will progress more rapidly if he does not attempt to use his prosthesis until his contracture has been reduced.

In standing and in slow walking on even ground it is reasonably safe to state that the normal individual uses his gluteus maximus comparatively little for pelvic balance. This was first pointed out by Duchenne.[3] Clinical observations seem to indicate that the muscles used for this purpose are those which originate from the tuberosity of the ischium; that is, the hamstrings and the posterior portion of the adductor magnus. Studies of muscle action during gait carried out by Scherb,[4] Francillon[5] and Mülli[6] indicate that the long head of the biceps, the semimembranosus and part of the adductor magnus come into action during the supporting phase of gait, while the short head of the biceps and the semitendinosus contract during the swinging phase. For convenience the former three muscles will be referred to as the inner extensor group.

In the above-knee amputee the hamstrings have been transformed from biarticular muscles, acting alternatingly as hip extensors and as knee flexors, to monarticular muscles with hip extension action only. Their point of insertion below the knee having been lost, they reattach themselves more or less securely to the stump. Because of decreased length, marked in short stumps, their power and range of contraction have been diminished. In balancing the pelvis on the ischial seat of the prosthesis these muscles are further at a mechanical disadvantage because their lever arm has been shortened. The fulcrum of motion, as stated above, is transferred from the hip joint to the ischial tuberosity; that is, these muscles now apply their force to a point which lies very close to the fulcrum (Fig. 2). To accomplish a certain amount of work, that of balancing the pelvis on its support, more effort must be expended than under normal conditions when the fulcrum is at the hip joint.

Because of the decreased efficiency of the inner extensor group it is very likely that the amputee uses his gluteus maximus to a greater extent in walking than does the normal individual. Whether this is the case, and to what extent it occurs, has not as yet been determined. It seems logical to assume that in very short stumps compensatory action of the gluteus maximus is necessary, an assumption which is supported by clinical observations.

It must be remembered that in slow rhythmic walking on even ground with proper alignment of parts very little actual muscle strength is needed. This is evident in some paralysis cases who learn to walk quite well although there is very little strength in any of the muscles around the hip joint.

To enable the inner extensor group to balance the pelvis in standing and in walking this muscle group must have retained its ability to perform work in the last few degrees of extension. If these muscles are unable to do so they are of no use unless the pelvis be permitted to tip forward, putting them on stretch, in which case the usual lumbar lordosis is inevitable. In the preprosthetic training of the amputee, therefore, special emphasis is given to stump exercises in the last few degrees of extension. For training of the inner extensor group the stump is kept adducted and internally rotated while extension is performed whereas the gluteus maximus is trained in extension and external rotation.

In examining a large number of thigh amputees it was found that, with very few exceptions, those who possessed complete range of hip extension combined with good strength in the inner extensor group were good walkers. Those who had complete range but who lacked strength in the last few degrees of motion did not walk well. The tendency of the latter group was to tip the pelvis forward, thus putting the muscles on tension until they responded sufficiently to give the amputee a sense of security. The usual lumbar lordosis followed. This condition may be called "active insufficiency" of the extensor group and it is almost as much of an obstacle to good gait as is a hip flexion contracture. The gait in these two conditions is almost identical. The method of correction obviously differs. It is suggested that preprosthetic routine include tests for "active insufficiency" as well as for contractures, and that specific nonweightbearing correction be continued after the amputee has started gait training, should either of these conditions be present.

Ankle Joint

The anteroposterior balance at the ankle joint of the normal individual, as stated above, depends to a certain extent on calf muscle action. The security of the body as a whole demands that a plumbline through the suprapedal center of gravity fall approximately through the center of the surface of support. This point is well in front of the axis of motion of the ankle joint, necessitating some action in the calf muscles. By placing more weight on the heels the plumbline can be made to fall through the ankle joint, thus eliminating the action of the calf muscles, but decreased stability follows. This, in fact, is the posture assumed by a subject with calf muscle

paralysis. If, on the other hand, more weight is born on the ball of the foot the action of the calf muscles increases. This is the position a person automatically assumes when he makes ready to move forward.

The absence of calf muscle action in the amputee has caused limbmakers throughout the centuries to experiment with the view of finding a good substitute for these muscles. The prosthetic literature, particularly the German one, gives abundant evidence of these attempts. No one invention has proved completely satisfactory. In fact, a jointless foot, made of hard rubber and set in equinus position has been recommended by many limbmakers in preference to feet with ankle joints. With absence of ankle motion and the foot in equinus the "rolling off" takes place over the ball of the foot and knee security is considerably increased. The gait, however, cannot be considered satisfactory. (Compare the gait of a person with quadriceps paralysis combined with equinus deformity.) The most commonly used arrangement today is a rubber buffer or steel spring placed anteriorly to the axis of motion of the ankle joint which when compressed checks dorsiflexion of the foot. This "front bumper" must be firm and allow only a small amount of compression before it blocks the motion. Thus as the weight is transferred forward over the supporting foot during walking the foot acts as one solid piece, allowing a rolling off motion to take place over the ball of the foot just like in the jointless foot. Free play in dorsiflexion or insufficient firmness of the front bumper causes difficulties. In the former case the amputee walks like a person with a calf muscle paralysis, in the latter case with a jerky motion. In both cases knee security is decreased.

Knee Joint

The problem of knee security of the above-knee amputee is a subject which has been much discussed. Prior to World War I it was considered good practice to place the axis of the artificial knee as far posteriorly as possible or to give the knee a hyperextended position to increase knee security. A considerable amount of effort was required to unlock the knee. The gait became jerky and fatiguing. In the modern prosthesis as in the normal leg the axis of the knee joint still remains posteriorly to a plumbline through the center of gravity of the supratibial mass, but the exaggerated posterior placement is avoided as is hyperextension. This is particularly applied to young and well developed individuals who are to use their prosthesis a great deal in walking. Through practice these individuals learn the skill required for knee control and do not need the extra security which a hyperextended knee gives. The latter type of alignment should be reserved for older people who need a stable "standing leg" for work but who do not expect to do much walking. A smooth and rhythmical gait can be achieved only if the knee unlocks easily, if the knee brake is properly adjusted and if skillful timing of knee extension and heel contact on the ground is learned.

In the normal individual rhythmic slow walking is accomplished with a minimum amount of quadriceps action. As has been pointed out by Fischer[7] and others, when the heel is placed on the ground the knee is extended or almost so, but the moment the heel hits the ground the knee flexes slightly and is thereafter again extended. This finely adjusted springy motion cannot be duplicated by the amputee, since it requires a short moment of quadriceps action. It is surprising how a nearly normal looking gait nevertheless can be achieved by the amputee.

When speed increases, the necessity for quadriceps action becomes greater. During rapid gait the knee is considerably flexed when the heel hits the ground. Such gait cannot be learned by the amputee. He should not be encouraged to attempt fast walking which necessarily would lack in smoothness and rhythm and be considerably fatiguing. For a short distance, if speed is desired, he uses with advantage the "step-skip" gait which consists of a hop on his good foot and a step on his prosthesis.

Knee control for the above-knee amputee becomes increasingly difficult in walking on uneven ground and in climbing stairs. The mechanics used in stair climbing by a subject with paralysis of the quadriceps muscle was described by Mayer.[8] A similar technic may be utilized by the above-knee amputee. With the prosthesis leading, in order to pull himself up on the next step, the amputee must lean sufficiently forward to bring the center of gravity of the supratibial mass anteriorly to the knee joint. A vigorous contraction of the hip extensors pulls the femur backward and causes a simultaneous extension of the knee and the hip. In ascending stairs the amputee necessarily must use a great deal of muscular effort, and he can succeed only if the hip extensors are strong, since these muscles alone are responsible both for knee and hip extension. Descending stairs, on the other hand, can be done almost without effort. The heel of the prosthesis is placed near the edge of the step so that the instep can roll over the edge without the toes catching. The trunk is maintained erect. At the

right moment the trunk is shifted posteriorly which causes the knee to buckle, and the sound foot catches the body weight on the next step. It is merely a matter of coordination and correct timing, not a matter of strength.

The security and control of the knee is one of the main problems in limbmaking. A great many artificial knees have been constructed and patented which lock and unlock mechanically, but none serves all purposes. The adaptability of the natural knee joint with its muscular control cannot mechanically be approached.

LATERAL BALANCE

Lateral balance on one leg in the normal individual as well as in the amputee requires adjustment at a great many joints and is accompanied by an intricate neuromuscular pattern. It is not the purpose of this paper to attempt an extensive analysis of the kinesiology involved, but rather to bring out a few points which may be of practical value to those who are engaged in the training of the amputee.

In order to balance on one leg the body weight must be shifted over the supporting leg in such a manner that a plumbline through the one-sided suprapedal center of gravity falls within the base of support, that is, within the sole of the supporting foot. In the normal individual the leg assumes a more oblique position in direction downward-medially, while the pelvis and the trunk shift laterally without any side bending of the trunk. The shoulders remain level. The two main joints involved in this shift are the hip joint and the subastragalar joint. At the former joint there is an adduction of the thigh in relation to the pelvis, while a motion at the latter joint causes an eversion of the foot in relation to the leg. Thanks to this subastragalar motion the entire sole of the foot remains on the ground to serve as a base of support.

The muscle action which accompanies this lateral shift and which enables a person to keep lateral balance in the one legged standing position may be analyzed briefly as follows:

(a) With the sole of the foot firmly on the ground the suprapedal mass is kept in balance through the alternating action of inverters and everters of the foot. The motion takes place in the intertarsal joints, mainly in the subastragalar joint.

(b) In balancing on one leg the head of the femur carries the entire weight of the one-sided suprafemoral mass. With the trunk erect the center of gravity of this mass lies medially to the femoral head, and action of the hip abductors of the supporting leg becomes necessary. In prolonged standing on one leg there is a tendency to lower the opposite side of the pelvis, which takes up the slack of the iliotibial band of the supporting leg. The iliotibial band may then partially or completely take over the action of the gluteus medius. The body weight, so to speak, "hangs" on it.

When the amputee balances on his prosthesis he should try, as far as is possible, to do it in accordance with the pattern of the sound side. He stands in front of a mirror while shifting his weight first over his sound leg and then over his prosthesis. When this motion has been fairly well mastered he practices balancing on his prosthesis while stepping forward and backward with the opposite foot, still observing himself in the mirror. Even when the prosthesis itself is well lined up, which is a prerequisite for success in balancing, all thigh amputees experience some difficulty in balancing on the prosthesis. This may be due to one or several of the following causes:

(1) Failure of the trochanteric joint to allow adduction of the prosthesis.
(2) Decreased stabilizing action by the iliotibial band.
(3) Contracture and (or) weakness of the abductor group.
(4) Tenderness of the stump on the lateral side, causing amputee to avoid pressure in this area.
(5) Lack of lateral motion of the artificial foot and loss of muscle action around the ankle.
(6) Loss of sensation—kinesthetic sense is disturbed.

1. The most commonly used trochanteric joint allows flexion and extension only, but no motion of abduction-adduction. If the pelvic band and the hip piece connecting it to the prosthesis are firm and snug fitting it considerably hinders the adduction motion which is necessary to bring the foot sufficiently under the body. However, the range of motion needed is rather small and there usually is enough give of all parts to allow some shift.*

2. After having been severed through amputation the stabilizing effect of the iliotibial band is decreased, although not completely lost. A certain amount of fixation of its distal end is obtained through connective tissue reattachment to the stump. However, its firm attachment on the tibia being lost, its function is seriously interfered with. To tense it the amputee must lower the opposite side of the pelvis more than normal. A "sinking" motion at the hip occurs which looks

*The Desoutter hip joint with free motion in all directions eliminates this difficulty.

very much like a "Trendelenburg." At first sight this sinking motion may be blamed on improper fit of the thigh bucket, since it looks as if the stump were sinking into the bucket on each step. On closer observation the two conditions may readily be differentiated. This sinking motion must be discouraged in gait training because it causes a very obvious limp and because it interferes with the natural rhythm in walking.

3. The condition of the abductor group as a whole is of paramount importance. If an abduction contracture is present the foot cannot be brought sufficiently under the body to allow correct alignment. A "tipping" of the trunk toward the side of the prosthesis is resorted to in order to gain balance (Fig. 4). Practically the same tipping occurs as in an abductor paralysis (gluteus medius gait). When the group is weak the amputee may either walk with a tipping motion, avoiding its use, or with a sinking motion, putting the weak muscles and the ligaments sufficiently on stretch to be relied upon. Either way

Figure 4. Poster used in gait training as an aid for the elimination of "side-tipping." (Drawn by Rosemary MacBird.)

the gait is unsatisfactory. Through intensive training both types of limp may be practically overcome in all but the very short thigh stumps.

It may be mentioned in this connection that ischial weight bearing causes a change in the mechanics of lateral as well as of anterior-posterior balance. With ischial weight bearing, as has been pointed out before, the fulcrum of pelvic motion during the weight-bearing phase is transferred to a point which lies posteriorly, medially and inferiorly to the femoral head. Whereas the length of the lever arm of the hip extensors is decreased by a posterior shift, the lever arm of the abductors somewhat increases by the medial shift of the fulcrum. Furthermore, it seems as if in ischial weight bearing, because of the posterior shift of the fulcrum the upper fibers of the gluteus maximus as well as the pyriformis muscle might to some extent be used for lateral balance. This assumption, however, is made on a purely theoretical basis and should be substantiated or disproved by proper investigation.

4. A tender stump, naturally, cannot stand much pressure from the prosthesis. Should the stump be sensitive on the lateral side, either because of scar tissue in this region or for other reasons, it seriously affects the gait. As the abductor group comes into action to balance the pelvis on each weight-bearing phase, these muscles pull the stump laterally, pressing it against the bucket. It is to be remembered that in the above-knee amputee, with exception of the Stokes-Gritti type, there is practically no weight bearing through the shaft of the femur. Hence the abductors will press the stump against the bucket laterally. The only way the amputee can avoid pressure in this area is to tilt the trunk toward the side of the prosthesis thus making weight balancing weight with the tuberosity of the ischium as the fulcrum of motion, eliminating the necessity of abductor action. The experience of the writer has been that some amputees succeed in eliminating lateral trunk deviation if they are told that they should feel the stump press against the bucket laterally. For this purpose a poster (Fig. 4) was made up which proved of considerable value in the training program. With a well fitting bucket, however, the pressure is distributed over a large area and the amputee does not feel an undue amount of pressure at any one point.

5. The usual type of artificial foot does not allow any "subastragalar" motion. The elasticity of the artificial foot together with some give in the rubber sole of the shoe may to a certain extent compensate for lack of lateral motion.

Many amputees, however, when balancing on the prosthesis feel as if the sole were "round," "like an egg." Because of the absence of lateral motion (eversion) the foot remains in its original alignment with the leg and the amputee cannot utilize the entire sole for support but must balance on the outer side of his foot. In so doing he decreases his base of support and balancing becomes more difficult. The amputee is not very likely to accept this difficulty since it is easier and feels more secure to compensate in a way which enables him to keep the entire sole on the ground. He does so by leaving the thigh in an approximately vertical position instead of adducting it, and again he gains his balance by tipping the trunk laterally toward the side of the prosthesis (Fig. 4). This difficulty exists both in above- and in below-knee prostheses and would account for the tipping not infrequently seen in below-knee amputees who do not otherwise have any reason for a hip limp.

Artificial feet have been constructed which allow lateral motion, but since this motion is not, like in the normal individual, controlled by muscle action, a certain amount of instability seems inevitable.

If the foot and the shin are so connected as to place the foot in a slightly everted position in relation to the shin without lateral motion being present, balancing on the prosthesis becomes easier. In that case, however, the outside of the artificial foot will be less firmly on the ground when the amputee maintains his body weight on both feet.

6. The amputee having lost all sensory impulses from the sole of his foot and from muscles and joints of the amputated part is not very well informed either of the condition of the ground or of the position of his limb. This state of affairs make balancing a very difficult process. All amputees when first supplied with an artificial leg insist on looking down on the ground to get the information they need. A great deal of practice finally enables the amputee to "feel" the ground with his artificial foot and to know its position without looking down. Balancing exercises, stepping over and creeping under obstacles, walking with "change of step," practicing various "fancy steps," following marks on the ground, and dancing, all contributes to a speedy adjustment. The sensory nerve endings of the stump develop an unusual acuity to pressure. Sensations set up are interpreted to inform the amputee of the position of his prosthesis, of speed and direction of motion, of the consistency of the ground, and so on, until looking at the foot is no longer necessary. The ability of such sensory reeducation naturally varies considerably among amputees.

Anteroposterior and lateral balance at hip, knee and ankle has been given a great deal of attention above, since an understanding of the mechanics of these joints during weight bearing is of fundamental importance. The training program is not limited to specific hip exercises, but these are rather part of the general conditioning program which includes swimming, playing games, horseback riding or any sport which appeals to the individual. Special attention is given to the training of abdominal and lateral trunk muscles which have a great deal to do with the control of the artificial leg.

Of equal or greater importance than actual muscle strength is coordination and rhythm. Walking is not performed by the legs alone but the entire body is involved. Unnecessary and prolonged muscle tenseness in any part of the body, be it in the hip region, of the abdominal muscles, around the shoulder girdle or in the region of the neck seriously interferes with rhythm in walking. The amputee is never told to hold his stomach in, his chest high, his shoulders back or his chin in, popular posture clues which are as much to be avoided in the training of the amputee as in posture training in general. Instead, relaxation and rhythmic motions are employed to obtain good alignment of parts.

A rhythmic swinging of the arms and synchronizing this motion with the pendulum motion of the legs is absolutely essential. Even steps is another point to stress, the tendency of the amputee being to take a long step with his prosthesis and a short one with the sound leg. For the single above-knee amputee no canes should be used. Relying on a cane causes faulty walking habits both in regard to weight distribution and rhythm. This was fully realized during the early days of the training program when the amputees were allowed to use a cane, a practice which was later discontinued.

An account of the organization of the training program of the amputee at U.S. Naval Hospital, Mare Island, California, will not be given here. For those interested in details of organization and in end results obtained, a film showing preprosthetic as well as gait training is available.

SUMMARY

A brief discussion of anteroposterior and lateral balance at hip, knee and ankle joints, as affected by the location of the centers of gravity of suprafemoral, supratibial and suprapedal masses is given. The balance of the amputee is

compared to that of the normal individual and some suggestions are made in regard to the training program.

1. Attention is drawn to the mechanical difficulty in anteroposterior balance of the pelvis as a result of ischial weight bearing.
2. Advantages and disadvantages of posterior placement of the axis of the knee joint in the artificial leg are considered. The "walking leg" is compared to the "standing leg."
3. The location of the center of gravity of the suprapedal mass in relation to the surface of support for maximum stability of the body as a whole, rotary forces at the ankle joint as result thereof; advantages and disadvantages of a jointless foot are discussed.
4. Causes of difficulties in lateral balance of the pelvis are analyzed, including instability of stump; decreased effect of severed iliotibial band; weakness or contracture of abductor group; tenderness on lateral side of thigh; loss of sensation.
5. Absence of lateral motion of artificial foot and its effect on lateral balance is discussed.
6. Importance of general conditioning, of posture training, of relaxation and rhythm is pointed out.

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The Technical Use of Surgical Corsets and Girdles

Charles LeRoy Lowman, M.D.

Corsets, girdles and surgical belts are misused more frequently than most other pieces of orthopedic and surgical apparatus. Often they are misused therapeutically, not by lack of indication, but because they are not properly prescribed and technically constructed to meet therapeutic needs. Many physicians do not seem to know exactly what they want the corset to accomplish technically, and will send a back or posture case to the corsetiere with a prescription that is no prescription at all.

The corsetmaker will need to know the kind of corset indicated, whether light or heavy, with high or low back and front, the weight, number and placement of steels, as well as the length of skirt (the latter to flatten or arch the back).

Let us analyze the points to be considered in making a corset for therapeutic use:

I. Corsets

1. High Back: To go over the scapulae at least up to the middle of the back; to be used for round back and round shoulder cases, arthritic cases, severe cervicodorsal neuritis cases, etc., and for rapidly growing pre-adolescent girls with marked shoulder droop.

2. Medium Back: To come just below the tip of the scapulae, placing the pressure on the thorax and serving to bridge the hollow of the back. This is the type most frequently used for ordinary wear.

3. Low Back: Little more than a girdle but giving some abdominal support and pelvic grip. Of use in moderate postural low back strain in which the spinal alignment is normal. Also for follow-up wear after a higher corset is no longer needed.

4. Steels: Are usually about one inch in width and come in 14, 16, 18 and 20 gauge. These are set in covers and fixed to the corset at any points indicated by the physician, but usually are placed about one to three inches each side of the middle of the back. The thickness or gauge should be indicated on the prescription and also how steels are to be bent —snugly-fitted, molded in to spinal curves, or fitted above and below to bridge the lumbar curve. For instance, in a spondylitis or painful spine case, the bars usually are molded in snugly. For a posture case or sciatic neuritis or lumbosacral condition they should fit snugly below, but not be molded in. In the high back type of corset the upper two inches of the steels should be bent to lie flat on the scapulae and not project out to show through the clothing. To increase the lateral stability and obtain some limitation of mobility, side steels may be used. Sixteen gauge is used for heavy people and where much rigidity is desired, but 18 gauge is the average. If the patient must wear the corset in bed, steels one and a half inches wide should be specified to distribute pressure widely and not dig into the patient.

5. Shoulder Straps: Shoulder straps should be ordered for undeveloped or small-breasted women and for boys (such as poliomyelitis cases) or, as indicated later under "Brassieres," the solid back "bra" may take their place. Shoulder straps are one and a half to two inches wide, of elastic webbing with a stockinette section under the arms and one-inch nonelastic ends. They are passed through carrier loops behind, go under each axilla, forward and around the shoulders, cross to carrier loop of opposite side, thence downward and forward to a buckle placed about two inches above and inside of anterior superior spines. The resultant pull is in line with the front portion of the corset, which is darted in to give an upward lift on abdomen when corset is laced. The line of pull through these straps increases when the shoulders droop forward. Naturally, straps should be worn as tight as the patient can stand comfortably. In severe round shoulder cases it may be necessary to use both straps and "bra."

6. Lacing: Front or back lacing should be specified. I prefer the back lace type because of the slanting angle of the pelvic bones. Pulling from before backward tends to pull the

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sacro-iliac joints together and applies more pressure of the steels to the pelvis in the attempt to flatten the lumbar curve. The front lace type is adequate for ordinary wear but does not follow up the correction of posture as it occurs. Arthritics or paralytics whose hands are involved usually manage the back lace type more easily. The lacings are for adjustment, but the closure fastenings may be zippers, hooks and eyes, or straps and buckles.

To put on the corset it should be fastened in front in proper location; then the wearer should lie down on the back, draw up the legs, then press down on feet, lift the pelvis and pull up the bottom lace loop. The abdominal organs will gravitate upwards, a better grip is obtained around the pelvis under the abdomen and the back is flattened. By putting on the garment in this way, constant correction goes on. When symptoms are overcome and corrective and strengthening exercises of back and abdominal musculature have been given, the patient may gradually work out of the corset and use it only for fatigue-inducing pursuits (shopping trips, long auto rides, etc.)

In a pregnancy the corset may be converted into a maternity garment by putting laces in front on each side, just to the inside of the anterior superior spines of the ilia. There should be three laces—the bottom six or seven inches pulled up tightly, the middle section less, and the top section still less. As the size of the abdomen increases this front will act like a shelf. With 16 gauge steels bridging the hollow of the back, the abdominal weight is not borne in the lumbar area (as is the case in many commercial types of corsets) but is transmitted above to the thoracic area. After childbirth the corset may be readjusted and worn to prevent the back strain so prevalent with women at that time.

7. High Front: Covering the rib margin just below the breasts but not high enough to press on them. Useful, especially in weakness or paralysis of abdominal wall, or in certain funnel-chested cases where costal margins flare downward.

8. Medium Front: Just below the costal margin—the average type.

9. Low Front: As may be worked out by the patient and corsetiere in relation to skirt bands.

10. Skirts — Usual Length: Usually long enough to hold down the corset—to be fitted at the discretion of the corsetiere. In a pelvis wider through the trochanters than across the ilia, and still narrower in the waist, it is quite difficult to keep a medium high back corset from riding up, for in bending and raising the arms it will tend to lift up. This condition often will tax the combined ingenuity of physician and corsetiere.

11. Short Skirts: When a long skirt is inconvenient, as is often the case with young women, it may be made only to the trochanters and under the anterior superior spines of ilia. To keep it down peroneal straps or leg bands should be prescribed. When, as in poliomyelitis, it seems indicated to use a corset on a boy with small abdomen, the peroneal straps will help counter the pull of shoulder straps. Leg bands, six-inch high circlets around the thighs, with elastic straps front, side and back, also are used for the same purpose.

12. Pelvic Portions: It should be indicated whether the pelvic portion is regular or fenestrated. Fenestration is of use when pelvic bones protrude and it is desired to keep a bone or steel from rubbing over the anterior portion of the crest. An oval piece of bias goods or chamois skin may be inset to give a tighter pelvic grip and hold corset down without a long skirt.

II. BELTS:

1. Cinch belts may be used when there are relaxed sacro-iliac ligaments. A canvas or leather cinch belt may be passed through carrier loops to pass just below the anterior spines in front and over sacrum behind. This serves to anchor the lower ends of back uprights and gives firm support to pelvic area without making the rest of the corset uncomfortably tight. Two metal circlets may be used in cases of hip subluxation in which the trochanter would tend to ride up. The cinch belt may be placed under or over the corset as the surgeon desires. An inner belt may be used to keep abdominal fat rolls from being pinched when patient is sitting.

2. Pads—sacral, kidney, hernia and sit pads:

Sacral: A pad to make pressure and give support often is useful over the sacral area. When the buttocks are muscular the mass on either side of the sacrum prevents direct pressure on it. A rhomboidal-shaped pad may be placed to fill this space (technically, the rhomboid of Michaelis.)

Kidney: When a patient has a prolapsed kidney and the urologist wishes a supporting pad placed in the corset, its position should be indicated.

Hernia: Pre- or postoperative, should be in-

dicated, as the surgeon desires.

Sit Pads: When the pelvis tilts laterally in the sitting position, a pad of felt held in a stockinette slip about three inches wide and six inches long may be hung from the belt, girdle or corset and hang down below under the buttock with its inner edge parallel to the cleft of the buttock. At its lower curves this pad has two tapes tied loosely around the thigh so that when the patient sits, the pad is drawn under the tuberosity of the ischium and corrects the tilt. Usually a half inch thickness of felt is pressed down to about a quarter or three-eighths of an inch, and ordinarily is enough to accomplish the desired result. If the patient is given heel correction for a short leg without inspection of the sitting position, the backache may continue and the compensatory curve in the spine will not be corrected. This oversight should be guarded against.

Many surgeons prescribe girdles and belts badly. Too often they are influenced by advertisements in medical journals or by presentations of detail men and convention exhibitors, and for backaches and injuries, simply send patients to a bracemaker with a prescription for a sacro-iliac belt. As most orthopedic surgeons know, there are very few really localized sacro-iliac lesions. Practically all low back symptoms come from sacrolumbar involvement and may or may not be combined with a sacro-iliac lesion. Simply putting a belt around the pelvis is not enough. To reduce movement of, and stress from superincumbent weight, and to control incident muscle spasm and pain, the lumbar spine must be bridged over. We suggest the use of six, eight, ten, or twelve inch height of back two-strap girdle which will come up onto the lumbar muscles with a central movable section which carries straps passed through carriers stitched to its side. These straps are fastened to the side sections of the girdle, pass through the carriers and are brought forward to buckles in the front.

In a three-strapped girdle, one back pad is about eight inches high and goes over the lower ribs and fastens in front to a proportionately higher abdominal section.

A four-strapped girdle will extend well up on ribs behind (about ten inches) and up to, or slightly over costal margin in front. This is really nearly a corset but is useful for men who do not need a brace, or as a follow-up after cast or brace treatment, lumbosacral fusion, etc. If desired to have a solid front with side-buckles it may be so specified. This type of belt is designed by me and may be prescribed as "Lowman type."

If a low belt for sacro-iliac grip is wanted, a sacro-iliac type belt should be prescribed. For thin persons without prominent, heavy abdomen, peroneal straps should be added.

III. BRASSIERES:

1. Regular Type: Full or medium width back, with straight or crossed shoulder straps. In most instances the "bra" should be over the corset and hold in the back steels so that they do not show through the clothing. For droop shoulders and heavy breasts the solid back type should be worn, with wide straps passing over the trapezius at an angle to lie smoothly and keep the weight of breasts from dragging on the tips of the shoulders. When crossed behind, the pull of the breast weight will be transmitted to the opposite side and help to keep the scapula of that side drawn in. The shape may be adjusted so that they are fastened either way.

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Attention to these technical details in prescription will not only result in indication of the therapeutic needs but will show the corsetiere and the patient that the physician knows what he is doing. The results in relief of symptoms and satisfaction of patients will be of special pleasure to all concerned.

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Orthopedic and Physical Therapy Objectives in Poliomyelitis Treatment

Henry O. Kendall and Florence P. Kendall

The problem of poliomyelitis treatment in the early stages of the disease and in the later stages of convalescent care is a complex one. Cases vary in severity of symptoms, extent of paralysis, and rate and degree of recovery to the extent that no two are alike.

Individuals who treat the disease are handicapped in their understanding of the entire problem because few, if any, have the time and experience which permit them to follow through the day by day care of cases from time of onset to final recovery.

Yet one must see clearly some objectives in his treatment, or he is lost in the confusion of what should be done for the patient. It is the purpose of this paper to present some simple objectives in a common-sense approach to the problem of poliomyelitis treatment.

To discuss treatments relating to poliomyelitis and to evaluate results in the final stages, there must be a common denominator. Correct terminology and a uniform understanding of the descriptive words employed is essentially the common denominator we need. We cannot add together the number of patients who show paralysis unless we agree on what the term paralysis means; nor can we add together the number of patients who have slight weakness, unless we agree on what constitutes such weakness. We cannot add together the number of patients who have "spasm" unless we all agree on what the term "spasm" means.

Two things must be carefully analyzed in preparing correct terminology for a condition: (1) The established meaning of the term. (2) The exact condition of the patient to which the term is being applied.

Many terms are used and loosely applied in relation to poliomyelitis. In defining terms in regard to muscles, the term "affected" must be clarified. At the onset of poliomyelitis the involvement may be so extensive that the entire musculature is "affected". Any muscle which exhibits hypertonicity is "affected" by the irritation of the disease. But the mere fact that the muscles exhibit this hypertonicity means that they are not affected to the extent that they are paralyzed. Muscles showing truly flaccid paralysis are so seriously "affected" that they are incapable of demonstrating hypertonicity. In using the term "affected", it should be applied to the muscles residually weak or paralyzed.

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Treatment

An intelligent approach in regard to treatment must be based on an understanding of the basic pathology in poliomyelitis.

Surprising as it may seem there is much present day discussion in regard to whether poliomyelitis is primarily a disease of the nerve tissue or of the muscle, fascia and skin. Scientific descriptions of poliomyelitis have consistently placed emphasis on the fact that the primary lesion is in the nerve tissue. Secondary changes do occur in the muscles and all associated tissue, either as a direct result of the loss of nerve impulse, as a result of the loss of motion, or interference with circulation.

If the fact is accepted that poliomyelitis is primarily a disease of the nerve tissue, one will appreciate more fully the limitations of treatment. He will not maintain false hope either for himself or for the patient he is treating by presupposing that the actual nerve paralysis can be diminished by early and constant treatment of the muscle.

In discussing poliomyelitis treatment it should first be emphasized that the words "method of treatment" should never be applied to poliomyelitis care. To speak of poliomyelitis treatment as a method is an injustice to any intelligent approach. There can be no mass treatment nor can there under any circumstances be an established routine.

Factors Influencing Treatment:

When someone asks "How do you treat poliomyelitis?", there is no specific answer because

every patient requires a different approach in treatment. In considering the treatment of the individual case, the following questions must be answered:

How long since onset?
How old is the patient?
What is the extent of involvement at present?
What was the extent of original involvement?
How much improvement has there been in individual muscles?
What kind of treatment has the patient had thus far?

Time since onset is important because treatment varies in many respects with the stage of the disease. The relation between duration of the disease and improvement aids in determining prognosis.

Age of the patient is very important because underlying bony and ligamentous structural variations must be considered in relation to treatment.

A comparison between the extent of the *original and present involvement* is important in considering further course of treatment.

The kind of treatment to date is important for various reasons:

Treatment which has allowed unnecessary contractures to develop distorts the poliomyelitis picture. Such contractures create a superimposed stretch weakness on opposing muscles. Neither an accurate diagnosis nor prognosis can be made until such secondary superimposed factors are corrected.

Treatment which causes stretch and relaxation of joint structures superimposes an even more serious problem than muscle contracture. It is more difficult to restore normal tightness to stretched ligaments than it is to restore joint motion in cases of some muscle tightness. One cannot determine accurately the power of a muscle if the joint is so relaxed that the muscle does not have a stable joint on which to act.

Early excessive and prolonged heat treatment tends to distort the degree of involvement. The basic reason for the use of the heat, in itself, explains this phenomenon. Heat is used to relax muscles and to act as a general sedative. When continuous and prolonged heat is applied, muscles lack their normal contractility. We observed an unusual situation in many 1944 poliomyelitis patients transferred from an isolation hospital where heat and stretching movements were employed in the early stage of the disease. Upon admission to the orthopedic hospital, more rest and less active treatment was instituted. There occurred a sudden, unexpected amount of improvement that was not at all typical of the usual course of progress in poliomyelitis muscles. Our explanation for this rapid improvement is that on top of the poliomyelitis weakness, which was not pronounced, there was superimposed a weakness due to too much heat and manipulation, which cleared up when such treatment was stopped.

Prolonged immobilization, which permits joint stiffness or unnecessary disuse atrophy to develop, also distorts the poliomyelitis picture and prolongs recovery.

Treatment Categories:

Early examinations of poliomyelitis cases will classify muscles or extremities or patients as a whole into three categories:

1. Essentially normal.
2. Weak (with or without imbalance).
3. Completely or almost completely paralyzed.

Each type requires a different approach in treatment.

All three problems may be exhibited in one individual, or there may be three individuals each exhibiting a single treatment problem.

Category 1:

Patients who, from the time of the first examination, show no weakness below 60 per cent or fair plus, fall into the first category. Such patients usually require no support or protection other than would be given in the form of good nursing care which maintains correct postural alignment in bed. Any muscle imbalances within this range of 60 to 100 per cent (i.e. fair plus to normal) must be watched in order to avoid an early tendency toward muscle tightness in the stronger of the two opponents. Passive or active motion through the full range of motion of the normal muscle is indicated. But, if restriction tends to develop in spite of passive or active movements, a support is indicated which places tension on the strong and lessens the tension on the weak.

Some patients show no muscle weakness but exhibit hypertonicity of the posterior neck muscles, erector spinae and hamstrings. If one regards this hypertonicity as a symptom of the disease, rather than as a result, he will hesitate to treat the symptom, except insofar as relief of pain is concerned. The presence of this symptom indicates that the disease process is still present in the cord, and early flexion motions which are directed toward treating the symptom are, in the minds of many people, contraindicated so far as treatment of the disease is concerned.

One has only to examine a large series of cases

in whom no effort was made to treat the hypertonicity to realize that this symptom usually disappears as the acuteness of the disease subsides. In a few cases posterior muscle tightness does persist, and treatment to restore normal mobility is indicated. The knowledge of what constitutes normal movements is of prime importance and will be discussed in detail later in this paper.

Patients who fall into the category of essentially normal will tend to get well regardless of the therapist or the technic, unless the muscles are overtreated. Danger lies in attempting to force recovery or in insisting on weight bearing during the early stage.

For the moment, let us skip Category 2 in regard to weak muscles and go to Category 3, the paralyzed muscles.

Category 3:

Some muscles on early examination may appear to be completely or almost completely paralyzed. Until sufficient time has elapsed to determine accurately the degree of paralysis of these muscles, it is necessary to treat them as weak muscles as discussed below.

The recovery during the first few weeks indicates the prognosis, and if muscles fail to show any significant increase in power during the first twelve weeks of treatment, little, if any, changes will occur. Once the status of the muscle strength is established the treatment indications become clear. Of prime importance is the maintenance of good body alignment and the preservation of joint stability. The range of motion and the position of fixation of each affected part are problems which should receive individual consideration.

Before discussing specific indications for treatment, let us carefully consider the chronic poliomyelitis patient.

If a youth or adult with a flail foot comes to an orthopedic surgeon two or more years after his illness, the logical procedure is to consider some type of foot stabilization. Stability is functionally more important than motion in the foot.

If a youth or adult comes to an orthopedic surgeon with a paralyzed wrist but good finger flexors, fixation in a position of wrist extension is indicated.

If a youth comes to an orthopedic surgeon with a disabling scoliosis which is progressing rapidly, and if conservative measures are inadequate, a spinal fusion is indicated. A straight rigid spine is far more desirable than a flexible spine which collapses.

These three examples show that free motion, uncontrolled by adequate muscle strength, is in each instance disabling. Stabilization of these parts restores function to as nearly normal degree as possible under the abnormal circumstance of muscle weakness. If we consider what this reconstructive treatment means, we may retrace our course from the chronic poliomyelitis to the early poliomyelitis patient, and it will become evident what we should do in early treatment. Just as soon as we can be sure that muscles of the foot, wrist or trunk are remaining paralyzed or very weak, we should direct our treatment toward a stabilization of that part in the position of best functional alignment.

Knees are not in the same category as the three examples above, because motion to 90 degrees is necessary for sitting. Most people would rather wear a brace that unlocks for sitting than have a stiff knee. Likewise hip joint motion must be kept free for the best function.

Treatment of a weak or paralyzed shoulder depends on the condition of the hand, the elbow and the scapular muscles and no general statement can be made except that the joint structures should be preserved as far as possible. With weak or paralyzed muscles, the load of the arm weight or the strain of passive movement is thrust on the joint capsule and ligaments, and unless care is taken to prevent injury to these joint structures, the shoulder tends to subluxate. Once this occurs further improvement in muscle strength just does not occur. The cosmetic effect, too, is very bad.

The discussion thus far in regard to Category 3 (paralyzed muscles) has stressed the indications for orthopedic care for the best end result in the youth or adult stricken with poliomyelitis.

Children are flexible and their ligamentous structures have not tightened, making the age of the patient an important factor in regard to treatment. Flail parts require extreme care and consideration to avoid deformities. Bony formation is not sufficiently established under ten to justify arthrodesis. The fact that the bones of the child are not completely formed makes them extremely susceptible to stress and strain in weight bearing. If a child walks with a foot in a position of varus or valgus the weight bearing will influence the formation of the bones of the foot and make it more difficult to perform a satisfactory arthrodesis at a later date. The practical application of these facts to the early treatment requires that if a child has a paralyzed foot, treatment should be directed toward maintaining good alignment both in weight bearing and nonweight bearing. A brace will probably be necessary until the

child reaches the age when stabilization may be done.

In the care of paralyzed or very weak muscles, it is not logical to advocate full and unrestricted motion of all joints of the body.

Category 2: Weak muscles and muscle imbalance.

This category has been left until last because treatment of weak muscles overlaps the treatment of essentially normal (Category 1), as well as the treatment of paralyzed muscles (Category 3). Many weak muscles will recover good or normal strength. Treatment that will nurse these weak muscles back to good strength is indeed worthwhile. Only a survey of cases with muscle tests, recorded at frequent intervals, and over a period of several years, can determine the effect of treatment on weak muscles.

The application of treatment in weak poliomyelitis muscles is based not alone on care of poliomyelitis patients but also on experience with the effects of exercise, strain, fatigue, weight bearing, etc., on patients with a wide variety of orthopedic disabilities. Observation of instances of weakness associated with stretch and strain of nonparalytic muscles in purely postural cases impresses one with the serious importance of proper care in treating muscles weakened by poliomyelitis.

In order to discuss treatment indications for weak muscles, it is necessary to analyze the causes of muscle weakness in poliomyelitis. There are five types of muscle weakness encountered in poliomyelitis.

1. Weakness due to the nerve pathology.
2. Disuse atrophy.
3. Weakness due to mechanical strain.
4. Weakness due to overfatigue which results from overactivity or overtreatment.
5. Muscle-stretch weakness.

Weakness due to the nerve pathology cannot be influenced by treatment. But during the very early stage of the disease when there is the possibility of reversal of disease process and spontaneous recovery[1] one must avoid activity which superimposes other types of weakness on the actual pathological condition. To this end, early weight bearing and movements which cause fatigue must be avoided.

Disuse atrophy may occur by restriction of activity but should be no more alarming than the disuse atrophy encountered in other orthopedic problems in which rest is imperative. Activity will restore muscle strength lost as a result of disuse atrophy.

Very little laboratory work has been done to determine the relationship of mechanical strain to muscle weakness. One must rely on clinical observations to guide in treatment of weakness due to strain. Mechanically a muscle is subjected to strain when it attempts to lift or carry a weight which the strength of the muscle cannot tolerate. Mechanical strain must be avoided during the period of early weakness to allow time for treatment directed toward hypertrophy of remaining muscle fibers. When weakness is present due to mechanical strain, the addition of heat, massage and exercise will only aggravate the condition of strain and increase the weakness.

Weakness which results from overfatigue is prevented by avoiding overactivity or overtreatment. Exercises must be graduated according to the patient's tolerance.

Arc of Motion and Muscle-stretch Weakness

In treatment of weak muscles we exercise through partial range of motion. As strength improves, arc of motion is increased so that after a muscle reaches 50 per cent (or fair) it is given full arc of motion in exercise. If, on the other hand, strength of some very weak muscles does not improve, we have gained stability and preserved alignment by not using full range of motion.

We adhere to the belief based on clinical observation of many cases that best recovery of strength occurs in weak muscles if arc of motion is limited in exercise.

This reasoning is best explained by considering clinical observations common to all of us. We have all seen cases of muscle stretch-weakness or paralysis. In its simplest form it is seen in dorsiflexors of the foot on nonparalytic bed patients. The foot is not dropped beyond normal range—but nevertheless, dorsiflexors weaken because they remain in a state of physiological elongation. The foot need not be down for twenty-four hours a day in order for such weakness to develop. Cared for during the day without any care at night, or vice versa, the muscles will begin to weaken.

"Muscle stretch paralysis" has been observed in cases of peripheral nerve injury in which, for example, wrist and finger extensors have failed to function although nerve regeneration has occurred. The return of function following application of a cockup splint in such cases is little short of spectacular.

In poliomyelitis patients this "muscle stretch paralysis" has been observed by many orthopedic surgeons who have found that either by application of splints or subsequent to some operation

there has been an unexpected return of power in a muscle seemingly paralyzed.

Even in a present day concept of poliomyelitis which has received much attention, there is described a pseudoparalysis or muscle stretch paralysis (or alienated muscle—in one of the several uses of the word "alienated"). The weakness or paralysis is described as being due to the fact that the muscles are maintained in a stretch position by an opposing group of muscles in "spasm". Again this does not mean a position of stretch beyond normal arc of motion.

In poliomyelitis patients, muscle imbalance often exists between opposing muscles in which the weak is subjected to constant tension by the pull of the normal or stronger opponent.

The important underlying factor in all these examples may be summarized: Muscles will weaken if maintained in a stretch-position (beyond the position of physiological rest) for a sufficient length of time. This stretch need not be beyond the normal range and need not be constant to cause weakness of the muscle.

The common observations in regard to muscle stretch weakness are interpreted in various ways. Some maintain that there is no reason to believe that repeated exercises through full range of motion can elongate muscle and cause weakness. They advocate stretching muscles in movement but at the same time claim that muscle stretch position is bad to the point of being paralyzing.

Stretch weakness is a weakness superimposed on the weakness due to nerve pathology. Recognizing the existence of this stretch-weakness in many poliomyelitis muscles, we avoid its occurence in two ways:

1. Use of proper supports which maintain a physiological rest position to avoid *stretch positions.*
2. Restriction of arc of motion to prevent *stretch movements* during treatment periods.

   This not only avoids unnecessary tension on the muscle, but avoids undue stress and strain on joint capsules and ligaments.

Muscle Imbalance Between Opposing Muscles and Within Muscles:

Poliomyelitis patients exhibit the phenomenon of muscle "cramps". These cramps are of two types and should be handled in two different ways.

Some muscle "cramps" occur in normal muscles which are unopposed or opposed by weak muscles. In this condition the entire muscle when contracting, as in exercise, shortens beyond its normal physiological limit. To relieve such a cramp in a muscle the part is pulled in the opposite direction to stretch out the over-all contraction. This fact that muscles may contract beyond normal is another point in favor of restricting arc of motion in exercise to avoid positions in which this contraction occurs.

Some muscle cramps occur in weak poliomyelitis muscles. There is no indication that an actual rupture takes place, but the uneven pull within the muscle creates an imbalance that puts a strain on one part and allows a transverse section to contract more than normally. Over-all heat and stretching motions will only aggravate this type of condition. If you watch a patient trying to relieve this type of cramp, you will find that he rubs over the "knot" in the muscle.

We should carefully analyze the type of muscle-contraction encountered in treatment of poliomyelitis muscles. An over-all muscle tightness needs stretching. Heat applied specifically and locally to the tight muscle is indicated. A transverse, segmental contraction within a muscle requires careful handling.

Evidence of segmental imbalance in muscles has been interestingly portrayed in pictures of operative exposure of poliomyelitis muscles by Hipp.[2] His article helps to clarify, in a way physiologists have not done, the clinical picture we see in weak poliomyelitis muscles.

Bracing:

The problem of treatment for weak and paralyzed muscles cannot be left without a discussion of indications and contra-indications in regard to the use of splints and braces.

When anyone says he does not use and does not believe in the use of such devices, he frankly admits that he does not know their indications. Information cannot be obtained from one who has never used such devices but must come from one whose experience and training have established the fundamental usefulness of such modalities.

Because orthopedists know more about the indications for such treatment than any other group of specialists, we went to one of the country's outstanding men in this field—Dr. George E. Bennett. We asked Doctor Bennett, "Why do you use splints and braces?" His answer was direct and to the point: "Braces are applied to protect weak muscles, to hold joints in alignment, to prevent deformity, and to facilitate function."

The need for bracing, or a check on whether bracing has been correctly applied, can quite well be determined by checking against the four points here outlined.

(1) Is the brace needed to prevent deformity? In growing children with generalized weakness

or muscle imbalance, the answer is almost certainly "yes". In adults, the answer usually is "no", because the bony and ligamentous development is sufficiently well established and strong enough to offset the danger of deformity.

Permitting a child to develop a hyperextended knee to compensate for quadriceps weakness can cause serious complications. A unilateral hyperextension may lead to lateral pelvic tilt with spinal deviation as well as anterior and rotary pelvic displacement.

The choice in bracing may be one of two: If free joint motion is to be permitted, the child must have stability by locking the knee. A brace then is designed to permit the desired mobility and extension, without permitting hyperextension which unavoidably becomes more and more deforming in unprotected weight bearing. If strength and stability of the knee are required more than free motion, a brace with a knee lock is used. This type of bracing carries with it the disadvantage that walking must be accompanied by a certain amount of pelvic motion; but the over-all effect is not as serious as the deviations associated with no bracing.

(2) Does the brace maintain joints in alignment? If alignment is distorted or parts are held in a faulty position, then a brace is helping to maintain a deformity rather than a normal alignment. Such should not be the case. If one waits until a deformity has developed before applying a brace, he has failed in the proper use of bracing.

(3) Does the brace facilitate function? If a brace handicaps an individual more than it helps him, surely it is not facilitating function. But the "pros" and "cons" must be carefully considered. Present restriction may mean prevention of future disabling deformities.

(4) Is the brace indicated for protection of weak muscles? In cases of known peripheral nerve lesions in such cases as wrist-drop or foot-drop, the application of a splint is a well established orthopedic procedure. The splint serves a dual purpose. First it prevents adaptive shortening or contractures from developing in the unaffected muscles, and secondly, it prevents stretch of the temporarily paralyzed group. The need for such splinting is determined by the muscle imbalance and the degree of weakness, and the procedure is applicable in cases of imbalance regardless of whether the pathology is in the peripheral nerve or the anterior horn cell.

As professional people let us help educate the patient specifically and the layman in general in an understanding of the basic principles involved in the use of supportive measures.

NORMAL FLEXIBILITY ACCORDING TO AGE GROUP

Before anyone attempts to treat abnormal conditions, he should have a thorough knowledge of what constitutes "normal". A survey has been completed which attempts to determine normal flexibility in relation to certain movements currently employed in the treatment of poliomyelitis.

With the cooperation of Elmon L. Vernier, Ph.D., Director of Health and Physical Education in the Baltimore Public Schools, and his staff of physical education instructors, we have obtained measurements on over 4500 school children between the ages of five and eighteen (kindergarten through twelfth grades). To this number have been added test results on 582 young adults between the ages of eighteen and twenty-two.

*Summary of Study**

The ability to touch finger-tips to toes, sitting with legs extended, is a known infant normal and from the study appears to be an adult normal. There is a decline in the ability to perform this movement from the infant and early school age to a low point at the age of twelve and thirteen (for boys and girls, respectively) at which approximately only 30 per cent can touch. There is a gradual increase in the number able to perform this movement up to 90 per cent for the adult males, and 95 per cent for the adult females.

The ability to touch forehead to knees, sitting with legs extended, is also a known infant normal, but drops suddenly so that by the age of six, only two out of 100 boys can perform this movement. Beyond the age of nine, only one out of 100 boys can do this movement. In girls, four or five out of 100 can perform this test, but approximately half of those who can touch have had early training in acrobatic or ballet dancing to make this ability acquired rather than inate.

REACTION TO PRESENT-DAY TREATMENT

Our own interpretation of what we see in much present-day treatment of poliomyelitis is this:

With the basic concept that "spasm" can cause an apparent paralysis, the reasoning goes on that if we rid the patient of spasm we will avoid the paralysis that might come as a result of such spasm. With curare, hot packs and early motion, the spasm is "reduced", no stiffness results, and without stiffness there will be no fixed deformities. The sum total of such reasoning is: (1) less paralysis, (2) no deformity, and (3) no stiffness

*Study complete with graphs and charts is being submitted by George E. Bennett, M. D., to the JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION.

nor contractures. And what more could one ask for in poliomyelitis treatment?

If the original premise is accepted, the rest seems logical, easily understandable, and extremely convincing. But the original concept distorts the entire problem in regard to poliomyelitis, and leads to false conclusions in regard to treatment. The early so-called muscle spasm is a symptom of the disease, not a cause of the true nerve paralysis.

There is no scientific evidence to prove that treatment directed toward relieving "spasm" lessens the paralysis or prevents disabling deformities.

Such treatment does tend to prevent stiffness and muscle contractures, so long as the patient is under treatment, and indeed in many instances, the extreme stretching is sufficient to stretch joint structures to the extent that they will never return to "normal". Patients frequently are more flexible than before they had poliomyelitis, but this factor often is a serious handicap to one with extensive involvement.

Treatment directed toward stretching muscles will delay fixed deformities in some parts of the body but will hasten disabling deformities in other parts.

On our firm belief that weak muscles must be nursed back gradually to allow return of maximum function, we challenge present-day "stretch treatment" with the prediction that end-results will show more apparent paralysis, as well as deformities, than should occur in good poliomyelitis after-care.

We are all treating poliomyelitis patients; we are all seeing the same symptoms, the same disease, the same problems in muscle imbalance and deformity, and, to a very great extent, the same type of end-results. The extent to which different forms of treatment influence end-results will determine the relative value of each form of treatment.

Discussions all too often center about differences between "new" and "old" forms of treatment, Let us instead discuss what is *good* and *bad*, using scientific medical knowledge and clinical experience as the basis for our reasoning.

SUMMARY

Uniform terminology is essential for common understanding of poliomyelitis problems.

Treatment indications are based on a variety of factors: Age of the patient, time since onset, severity of involvement, rate of improvement, and type of treatment thus far administered.

An understanding of the purpose of treatment is best approached by an analysis of muscles (or cases) according to three categories: (1) Essentially normal, (2) weak, with or without imbalance, and (3) completely or almost completely paralyzed.

Indications and contraindications in regard to the use of braces is discussed from an orthopedic standpoint.

Test results on over 5000 individuals show age group differences in flexibility movements involving the back and posterior leg muscles.

Much present-day poliomyelitis treatment is based on concepts which lack sound orthopedic basis.

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2. Hipp, H. E., M.D.: J. Bone and J. Surg., Jan. 1942. Southern Med. J., Vol. 34, 1941.

Exhibits Available

Posters

1. Set of two entitled "Physical Therapy Procedures," each containing eight black and white photographs of physical therapy activities.
2. Set of two on "Posture." Good and poor postural positions are shown together with exercises for correction of faulty posture.
3. Poster exhibiting reprints available in the physical therapy field.

Slides

1. Set of 38: "Physical Therapy Procedures." Title slides are included in the group.
2. "Course Content in Physical Therapy,"—18 slides showing material covered in physical therapy training. Especially suitable for talks to student groups.

Album—Photographs of physical therapy procedures.

The slides and album may be borrowed from the National Office of the American Physiotherapy Association, 1790 Broadway, New York 19, N. Y. All other requests and correspondence regarding exhibits should be directed to Maxine Schuldt, Exhibits Chairman, 2031 Dwight Way, Berkeley, California.

Methods of Treatment for the Cerebral Palsied

Robertine St. James

As a professional group, all of you are aware of those persons handicapped with cerebral palsy. To some of you this awareness is remote from your own particular interests and duties. This is perfectly natural. Others of you have had occasion to meet them more directly and to feel, perhaps, the stirrings of compassion and a curiosity about them. There seems to be an aura of mystery about the cerebral palsied which serves to intimidate and to discourage the great majority. Some of you who have experienced those transient stirrings of imagination have succumbed to the "mystery" of it and retreated. Perhaps this is because of some feeling of inadequacy within yourselves or from discouragement for the length of time involved in the physical rehabilitation of these children and the questionable end results, or because of lack of interest and cooperation on the part of your superiors and coworkers. This, too, is quite natural. But some of you have not retreated. A few have plunged whole-heartedly into the "mystery" of cerebral palsy and found none there. There is only a challenge to ally yourselves with this isolated group, to meet opposition and criticism, to be discouraged sometimes, to work, not with just your hands and a few fundamental principles of massage and muscle training, but a great challenge to work with your hearts and your minds.

An accurate diagnosis is the basis of any training program for cerebral palsy. Following a classification of type, and before any formal treatment is begun, a psychometric examination should be given in order to evaluate the mental potentialities of the patient. This must be done by those who thoroughly understand the language and motor handicaps of the cerebral palsied.

Our psychologist at Elizabethtown has incorporated the Rorshach test—a projective psychological technic—into her study of the child. She feels that there is a need for evaluating the individual's emotional maturity, of estimating the tension under which he is living or the strength of any undue anxiety which may be coloring his psychological life. There is, she says, danger in relying solely on intelligence scores, for many low intelligence scores may be the result of an emotional disturbance rather than of intellectual deficiency.

Whatever the findings, our programs are limited and time and energies are not expendable; therefore, it is only fair to the educators and specialists involved in the rehabilitation of these children that they be allowed to work with those of average and above-average intelligence.

This does not suggest that the mentally handicapped cerebral palsied person be ignored. Under the supervision of a physical therapist, a program for training in self help, speed and locomotion can be worked out and relegated to the home.

The five classifications of cerebral palsy are spasticity, athetosis, ataxia, tremor and rigidity. By way of review, spasticity represents a hyperirritability of muscle to stimuli. It is characterized by the stretch reflex, which is an involuntary contraction initiated by the voluntary contraction of an antagonist. In this type of cerebral palsy there may be found muscles which are flaccid (cerebral zero), weak and normal, as well as spastic. Differentiation is necessary before muscle reeducation can be effective. Briefly, the spastic muscles must be taught conscious release while the weak and flaccid muscles respond to massage and exercises, progressing from passive to active-assistive, active to resisted, given without exciting a stretch reflex or causing overflow to another part of the body. The aim of treatment for the spastic is to gain and maintain full range of joint motion, establish rhythm and speed in reciprocation and to avoid substitution.

Athetosis is characterized by involuntary motions which interfere with normal movements. Athetosis may be either tension or nontension in type. Tensions are secondary to athetosis, built up by a constant effort on the part of the patient to block out or control the involuntary motions. Nontension athetosis is manifested by a series of purposeless motions without pattern. The tremors also are characterized by involuntary contractions which are reciprocal in nature, regular in

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rhythm and of two types: (1) intention tremor, in which contractions occur only on attempted movement, and (2) non-intention tremors, in which the contractions are present at all times. Consequently, the treatment of athetosis and non-intention tremor is essentially the same, the objective being to develop conscious relaxation and to establish motor patterns which will enable the patient to perform purposeful movements with a minimum expenditure of energy.

The training for conscious relaxation starts in the patient's most comfortable position, with attention focused on one joint at a time, beginning with the proximal and working distally. When a fair concept of relaxation has been developed, passive motions are begun, again working from the proximal joints distally, through full range of motion. When passive motion can be performed with ease, active-assistive and active motions are added, taking care to avoid substitutions and overflow.

The development of relaxation and motion from the relaxed position begins on the table, but it is desirable to work into a more functional position as early as possible. The relaxation chair accommodates this transition from lying to sitting.

Ataxia is caused by a disturbance of automatic balance control with a characteristic loss of kinesthetic sense. All treatment for the ataxic must be given in a functional position with any tactile or visual stimulation employed which will make it possible for the patient to know when he has completed a movement satisfactorily. The aim of treatment is to teach the patient substitution of voluntary or cortical control for cerebral control.

Intention tremor, mentioned before, occurs only on attempted motion. Therefore, the aim of treatment is to teach conscious relaxation and motions from a functional position.

A formal training program is not always indicated for patients with rigidity since it is the result of a diffuse lesion with mental retardation in the majority of cases.

Discussion of formal table technics purposely has been limited in this paper. More detailed instruction may be found in the "Handbook on Physical Therapy for Cerebral Palsy."[1] It is an excellent source of material on cerebral palsy and serves competently as a guide to physical therapists in the treatment of cerebral palsy.

Although the underlying principles of treatment are confined to table technics and formal muscle reeducation, it must not be presumed that this, in itself, will suffice to meet the multiple needs of these children.

There has been and is a tendency for the cerebral palsied to be much too inactive. We cannot expect much progress in balance or muscle strength, for instance, if the child is kept in bed for twenty-three hours a day, seven days a week. The normal three-year-old child is on his feet approximately six hours a day. Therefore, with the cerebral palsied we must aspire to approach the normal developmental processes in order to hasten their physical rehabilitation.

How to do this is perhaps one of our most difficult problems. Many of us are handicapped by lack of personnel and equipment. Apparatus is the logical supplement to formal treatment, and personnel is necessary for the application of apparatus and supervision of activity while in apparatus.

Let us assume that one physical therapist is treating eight or ten cerebral palsied patients a day. Her time of necessity must be budgeted, balanced between the moderately handicapped and the more severe. Theoretically, her time is exhausted at her treatment table with massage, relaxation and muscle training, plus a few wedged-in moments of balance work. Because of the time element, the child, after treatment, is whisked back into bed or into a chair, forgotten until the next day.

To inject one personal observation: I believe that the cerebral palsied patient should be treated every day (except weekends); I believe that in order to get the maximum improvement in the minimum amount of time, it is necessary to do table work, balance work, fundamental speech work and reciprocation five days a week, several hours a day.

A program such as this, of course, is most easily adapted to the preschool group. It can and does work successfully in the home situation where there is interest and cooperation. In an institution it seems feasible that one trained attendant could take over the responsibility of carrying out and supervising a planned program of functional activities for one group of children. The day schools and orthopedic schools suffer some limitation in the execution of this type of functional program.

Of all appliances used, bracing is the most important. Those of you who are privileged to work with Doctor Phelps are familiar with them and will agree that they are indispensable to the training program of the cerebral palsied. Generally it may be said that braces are used (1) to prevent and correct deformities; (2) to support weak and ineffectual muscles; (3) to control wild, involuntary muscle pulls which tend to throw a child completely off balance. In the first instance we encounter a child who has an equinus tend-

ency with, perhaps, an associated hamstring tightness. With bone growth and an increased amount of muscle pull, these structures are inclined to become more and more tight. If the condition is allowed to persist, there may develop, over a period of time, a real contracture which *may* work out with subsequent bracing but which, more probably, will require surgical intervention. The point is that with early and persistent bracing we can eliminate such deformities and keep the range of joint motion fairly well within normal limits.

In this same type of child there is probably a strong adductor pull, causing a scissors tendency. Thus we see him standing on his toes, with or without some knee flexion, and with the legs crossed. What chance does he have for learning standing balance, to say nothing of walking? In a pair of long leg braces with pelvic band, drop lock knees and right angle stops at the ankles, this same child can assume a normal standing position from which point, by physical therapy and apparatus, balance reflexes, reciprocation, muscle strength and coordination can be speeded up. Once standing balance is established, walking is not too remote.

Another type of child we see is the one with the "weak and ineffectual" muscles—those about the hips, knees and feet which are too weak to support the weight of the body. This child needs lots of massage and muscle training to build up the strength of the weak and flaccid muscles, and the building up process is slow and labored. There are two courses open here: massage and exercises over a long, long period of time, until those muscles have acquired enough strength to consider standing and walking; or *bracing plus* massage and exercise. In braces such a child can proceed immediately with standing balance and walking with various types of apparatus, and because of the increased physical activity, muscle strength is built up more quickly and reciprocation and balance are constantly improving. He becomes ambulatory faster and eventually the braces can be discarded.

A third type with which you are all familiar is the athetoid. Here we have wild, involuntary motions of both the arms and legs, and an associated involvement of the trunk and neck. Consequently, when all four extremities start "acting up," even sitting balance is difficult to maintain. For these children we use athetoid control braces which are similar to those already described, except made of heavier metal because of the strong athetoid pulls. These braces act to subdue involuntary motion and incoordination and to govern foot placement. Even in sitting they tend to act as a stabilizing factor, thus encouraging increased relaxation in the trunk and upper extremities.

At Elizabethtown, upon Doctor Phelps' recommendation, we use only removable caliper braces. These insert into a caliper box at the heel of the shoe and make it possible for the brace to be removed from the shoe. There are several reasons for this.

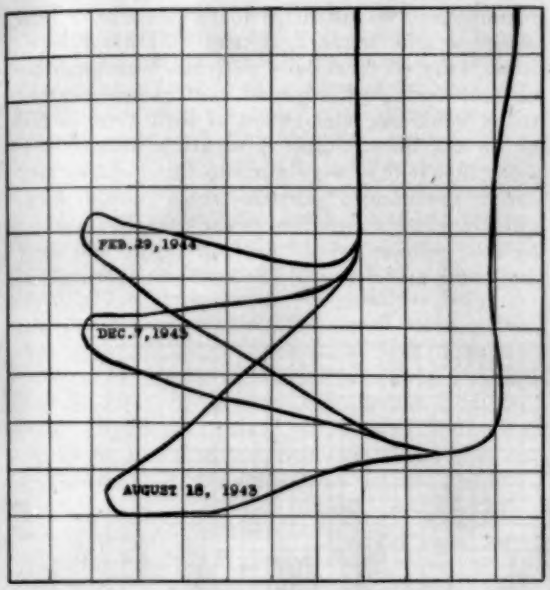
When walking with braces has been established, we immediately begin to think about developing standing balance and walking without braces. With the removable calipers the same shoes can be worn for this practice work. Also, with children who have marked tightness of the heel cord, it is difficult to apply the shoe with the brace attached and to be sure that the heel is well down into the shoe. By applying the shoe first, lacing it securely and then applying the brace, we know that the foot is in the preferred position.

We use both day and night braces for most of our spastics. Where there is an equinus tendency without hamstring tightness, we use a short, round, outside bar caliper for night wear. This has great value in acquiring and maintaining gained joint motion. It is set up to maximum tolerance of dorsiflexion with some inversion, with periodic increases as the heel cord becomes freer, until full range of joint motion is acquired. The night brace can be applied to the same shoe worn with the day brace, thus eliminating the necessity for two sets of shoes.

Double bar short caliper braces are used when the involvement is located in the dorsi- or plantar flexors. If there is an equinus tendency, these braces with a right angle stop control the foot drop to give a better stability and walking picture. Similarly, when there is a calcaneous tendency, the double bar short calipers are used with a reverse stop.

It is also a standard order at Elizabethtown to have metal sole plates incorporated into every brace shoe. Without these we have found that the tremendous "push-down" which so many of these children have eventually breaks down the shoe to allow some forefoot drop. This slight degree of foot drop might not seem important offhand, but it does upset anteroposterior balance by allowing the plantar thrust to throw a child backwards.

Bracing for cerebral palsied patients is fairly intricate. We are still trying to convince our brace men that a mechanically perfect brace must sometimes be adapted to the idiosyncrasies of the cerebral palsied child in order for it to be effective. Very minor adjustments often spell the difference between standing and not standing—walking and not walking.



Figue 1 (J.N.) Right spastic monoplegia—passive dorsiflexion with the knee straight.

The importance of bracing as an adjunct to physical therapy is shown in the accompanying graphs. The first illustration is that of a right spastic monoplegic (Fig. 1). It shows the improvement in range of joint motion over a period of six months, with vigorous heel cord stretching by means of a night brace. We have found that correction by bracing is more satisfactory in many cases than correction by surgery. With surgery to the gastrocnemius there seems to be a residual weakness which is stubborn in its return and seriously impedes walking. With bracing, the gastrocnemius seems to retain its functioning power, reciprocation between dorsi- and plantar flexion is better balanced and the gait is of a more nearly normal quality.

Figure 2 is a graph of a young athetoid's standing balance timed in seconds. This child wore short leg braces over a period of five months, during which time standing balance could not be maintained for more than a few seconds. The sharp rise indicates an immediate improvement with the application of long leg braces with abduction bar.

A boy, a spastic quadriplegic, working in short leg braces over a period of eight months had had absolutely no improvement in his standing balance (Fig. 3). Almost immediately after long leg braces with pelvic band were applied, he began to acquire standing balance which became consistently better.

The number of steps taken without assistance by a tension athetoid quadriplegic are shown in Figure 4, in order to demonstrate that bracing must be worked out to suit the individual. This girl did not work well in bilateral long leg braces, nor did she do well out of braces with twisters. Because of the overflow to the plantar flexors of her right foot, a short leg brace was applied, fol-

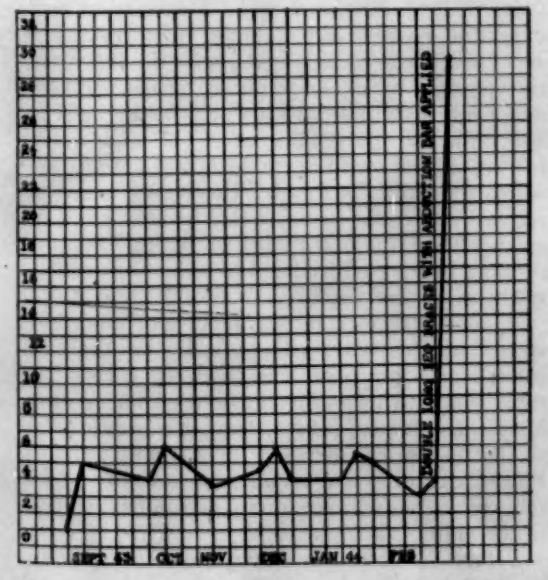


Figure 2. (P.H.) Athetoid—standing balance timed in seconds.

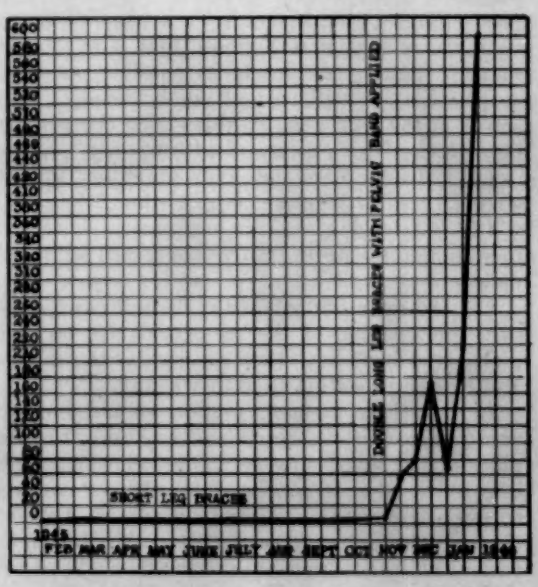


Figure 3. (R.S.) Spastic quadriplegia—standing balance timed in seconds.

lowing which her walking became markedly improved. Apparently, with her, the long leg braces were too restricting and interfered with her balance. Without them the overflow to her right gastrocnemius threw her off balance, too. When this was controlled with braces, she progressed rapidly.

In the developmental process of these children, creeping often is delayed and frequently never accomplished. There may be some question of how much importance should be attached to this phase of development. Creeping seems to be a pretty natural progression in the scheme of things so it seems logical to suppose that if we follow nature's pattern as closely as possible, as early as possible, we will be that much ahead of ourselves in the long run. To this end a creeper has been devised with a three-fold purpose:

(1)) To increase muscular nutrition, muscle strength and to improve coordination.

(2) To develop position and muscle sense and to stimulate the nerve centers connected with that muscle sense.

(3) To train undamaged cortical areas to take over the function of the reciprocal arm and leg motions in creeping which are similar to the arm and leg reciprocation used in walking.

In using the creeper, motion should be balanced in amplitude, speed and rhythm. The amplitude and speed may be increased when there is evidence that it can be done without causing spasm, tension or incoordination. A regular rhythm must be maintained. All work is begun as passive reciprocal motion, carried through active-assistive to active motion.

A special chair in which the child feels comfortable and secure helps to reduce tension and overflow and encourages arm and hand activities. Many cerebral palsy patients, because of the characteristic lack of head control and marked trunk weakness, spend most of their time in bed or on the floor. Again it seems logical to presume that if they were put into fitted chairs very early, undamaged cortical areas would more quickly adapt themselves to the upright position, balance reflexes would develop faster and neck and trunk muscles would become stronger sooner.

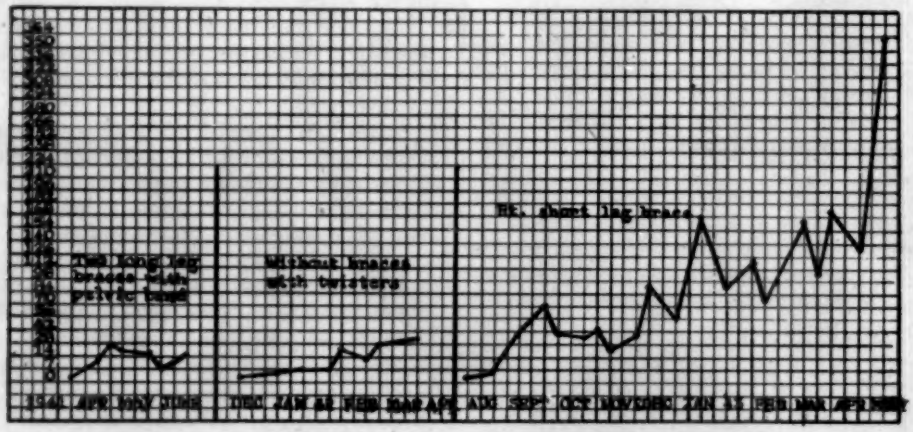


Figure 4. (M.A.D.) Tension athetoid quadriplegia—number of steps without assistance.

Another piece of equipment which is extremely valuable is the standing table. This may be individual or multiple but it should be adjustable to accommodate several heights, with the top extensive enough to allow plenty of space for arms and hand activities, whether it is to be used by one child or more than one. The outstanding feature of the standing table is the cutout, into which the child fits snugly. There must be ample support all around in order that he may stand for extended periods without becoming fatigued through balance efforts, and to minimize overflow to the arms and trunk.

A combination standing table and chair, designed by Rebecca Hastings, is by far the most satisfactory thing we have had. In sitting, the table acts as a tray and can be used for feeding, hand activities and school. The table is adjustable so that it also can be used for standing balance. Flared legs give it a remarkable stability and a removable body brace gives additional support to the child.

Before the child can attempt to stand or walk, he must have head control, sitting balance and, preferably, knee standing balance. When he has

arrived at this point, we can begin to think about walking. Ski-poles are excellent then, their function being to teach leg reciprocation, anteroposterior balance and to strengthen trunk and leg muscles. It starts as passive motion, goes to active-assistive and finally active motion. The skis are made approximately three times the length of the shoe, five inches wide, with the foot piece on the middle third. Inside boards eliminate internal or external rotation.

When a child has mastered the ski-poles and established anteroposterior balance, we try him in reciprocal action skis. These have canes at the sides to replace the poles in front. The canes are arranged for anteroposterior swing and can be controlled by wing screws to be movable or stationary. In the reciprocal action skis, the child assumes a more nearly normal standing position, lateral balance is encouraged and normal arm and leg reciprocation can be worked out through passive-active-assistive and active motion.

Parallel bars and graduated steps are additional aids for exercise purposes.

A great many cerebral palsy patients have weak glutei medii and external rotators. As a means of supplementing table work, an external rotator machine was developed. The principle of it is to give resisted external rotation by means of weights on the pulley ropes, with passive return by virtue of the same weights. This apparatus is not indicated in those patients who have spastic internal rotators because of exciting the stretch reflex.

When standing balance can be maintained for a few minutes and reciprocation is fair, we turn to crutches, canes and independent walking. If the arms are all right, or do not have too much involvement, crutch walking is fairly easy to accomplish. Even with serious arm involvement children can be taught to control the crutches. We concentrate on crutch walking until the patient has worked up good speed, endurance and selfconfidence, after which he graduates to full time walking without supervision. Then our walking program consists of training with a cane or canes, and finally without any apparatus. Naturally, a great many will always require some sort of apparatus for walking.

Two of my patients had marked involvement of one arm and fairly good control with the other. When both of these boys had achieved good standing balance and leg reciprocation, a walking program was indicated. In neither case was balance good enough to attempt walking without some sort of apparatus. Several things were experimented with and a tripod cane finally was made from an old crutch. Jake, a severe tension athetoid quadriplegic, worked up remarkable speed and balance, progressed to a cane and when he was discharged, could take over 200 steps without any apparatus. Incidentally, on his first admission to the hospital he had to be strapped in a special chair—he could not stand, walk or sit unsupported. With his tripod cane, he now attends public school and is completely independent. In spite of the severity of his handicap, it took only a total of three years of hospitalization and treatment for him to become ambulatory and adequate in self help.

CONCLUSION

The problems of cerebral palsy are manifold, but they are not unsurmountable. The training period *is* long and arduous, but with very early and very intensive treatment, we should realize a concomittantly early improvement and independence.

The purpose of any program for the orthopedically exceptional child is to develop a better functional ability of the parts involved and to equip him, through training, to meet the physical demands of everyday life. With the cerebral palsied the end results are measured entirely by the initial handicap and we must not forget that whatever the end result may be, it is the fruit of timeless effort, repeated frustration and dogged determination. It *must* be respected.

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Cerebral Palsy

Julian E. Jacobs, M.D.

The complete field of cerebral palsy includes congenital defects as well as injuries and diseases of the various parts of the brain which affects any type of motor control.

Of the 3,600 cerebral palsy cases in North Carolina under 21 years of age we have over 1,200 mentally normal, highly treatable patients who could be rehabilitated. There are another 600 cerebral palsy cases under 21 years of age who are so mild they need no treatment. There are approximately 600 cases who are mentally normal, yet so severe as to the type of paralysis that very little can be done except under custodial care and education. This leaves one-third of all cerebral palsy cases (about 1,200 patients) who are feebleminded and require permanent custodial care. Our major obligation lies with the 1,200 treatable cases mentioned above.

The statements made by W. J. Little in 1843, in his publication "Nature and Treatment of the Deformities of the Human Frame," still hold true. "The effects of the derangement of the brain or cord may be limited to the functions of a single muscle . . . or a larger number of filaments and more muscles may be affected."

"May present itself as a congenital affection or as a result of disease during infancy. It is often difficult and sometimes impossible to discriminate. . . . In some instances, however, the weakness of intellect appeared to result less from permanent injury to the brain than from want of sufficient training and education. . . ."

"An infant prematurely born . . . inadequately prepared to contend against the operation of external agents . . . altered function, congestion, or disease of the most susceptible of the infant's organs, those of the nervous system, could occur."

Congenital defective development of various parts of the brain, birth injury, anoxemia, birth pressure changes, and postnatal trauma are listed as the more common factors in etiology. Contrary to public opinion errors in obstetrics account for less than three per cent of all cases.

The acute infections (measles, whooping cough, meningitis, encephalitis, etc.) must be considered. The effects of alcoholism, syphilis, vitamin deficiencies and toxemias during pregnancy have been mentioned. Certainly prematurity with its inadequately developed central nervous system predisposes to cerebral palsy. Actual trauma, such as from forceps, fractures or blows to the head, add to the toll.

In general, then, spastic paralysis, or Little's disease, may be described as a disease, congenital or acquired, resulting from sclerosis of cells of the upper motor neurone, varying in degree and usually causing a hypertonicity of the muscles of the part affected. Orderly inhibitory stimuli of central origin do not reach the primary reflex arcs. In contrast to the more or less constant picture of hypertonic muscle reaction are the bizarre entities which we group under the general term of choreo-athetosis. In these, control of purposeful motion is distorted. Little's disease presents a picture of disturbed function of the corticospinal (pyramidal) tracts, whereas the latter group presents disturbed function of the tracts from basalar nuclei (extrapyramidal) tracts. An overlapping of these clinical pictures occasionally occurs.

In discussing the pathology and treatment the classification of Phelps has been used.

(A) The pathology in athetosis (choreo-athetosis) which makes up about 40 per cent of all cases is one of involvement of the basalar nuclei, especially Deiter's nucleus, the red nucleus and the corpus striatum. Many of these cases are normal mentally and treatment consists primarily of training them to relax (Jacobsen), using braces as indicated, and dilantin sodium (½ grain to 1½ grain t.i.d.p.c. to start with, increasing or decreasing the dosage according to age and individual response). The latter drug works best in the tension athetosis cases. Orthopedic surgery has very little to offer these cases but neurosurgery still has its opportunity, such as anterolateral cordotomy (the rubrospinal tract—

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Putman), surgery on the basal ganglia (Meyer and Browder), or on the cortex (Klemme and Bussey).

(B) The pathology in true spastic paralysis which makes up about 40 per cent of all cerebral palsy cases is one of involvement of the pyramidal tract (usually motor cortex) or along the corticospinal tract. Many of these patients are normal mentally and treatment consists primarily of encouraging these cases to manifest some coordination at which time training, braces, various orthopedic procedures (neurectomies, tendon lengthening or transplants, stabilizations), and medication in the form of prostigmine are of great value. This drug seems to facilitate reciprocation of antagonistic groups (by lessening the stretch reflex). We, in the clinics, have used prostigmine in the tablet form (bromide) starting with 5 milligrams t.i.d.p.c. orally and working up to 15 milligrams t.i.d.p.c.; prostigmine methylsulfate, 1:2000, 1.0 cc. one to three times a day, in hypodermic form is used during their hospital stay. Atropine sulphate (1/300 to 1/150 grain) is used once a day if one feels that salivation, slow heart rate or increased peristalsis is a major side effect. We rarely see its indication especially in children under seven years of age.

(C) The pathology in the "rigidity" cases is usually one of multiple petechial hemorrhages in the brain or one of anoxemic changes. This results in "lead pipe" response in their extremities. A high per cent of these cases are feebleminded. Prostigmine therapy here offers the best results considering the degree of brain damage.

(D) The pathology in the ataxias is one of cerebellar lesions or occasionally eighth cranial nerve involvement—training in balance and reeducation helps here. A trial at hyoscine and prostigmine always is indicated.

(E) Tremors—here the lesions usually are one of acquired cerebral palsy such as paralysis agitans and responds moderately well to hyoscine. We have used Rabellon (Sharpe and Dohme) starting with ¼ sections of a 0.5 milligram tablet b.i.d.p.c. and increasing the dosage according to the response.

(F) Flaccidity—as seen as a component of spasticity is likewise treated with prostigmine. We feel that prostigmine therapy should be administered for at least two months before discontinuing the drug because of lack of response. It has been our experience that in true spastic paralysis cases the speech responds best, the arms next and the lower extremities least of all. We feel this is fortunate in that surgery offers its relief in just the reverse. If the patient responds, we continue the drug for at least six months, repeating the drug after a month or two of rest. We feel that improvement gained under the drug seems to be maintained after it is discontinued.

SUMMARY

The incidence of cerebral palsy in North Carolina is reported. The etiology, pathology and medical treatment are briefly reviewed.

CONCLUSIONS

Cerebral palsy can be benefited by specific medications (dilantin sodium, prostigmine, hyoscine and its derivatives) in certain cases. Only by adequate evaluation of the cases and a trial at medical therapy is one able to determine the case that will respond.

Question: What well-known English physician of the seventeenth century once sent a patient several hundred miles to consult a nonexistent consultant? *Answer:* Thomas Sydenham sent a victim of hypochondria to Scotland telling him to consult a certain doctor of great skill. The patient made the arduous journey by stagecoach to find no such doctor existed. He returned to London full of rage, but cured of his complaint.—*From "Catechism in Medical History," The Canadian Medical Association Journal, Vol. 48, No. 2.*

The Physical Therapy Approach to Speech Problems in Spasticity and Athetosis

Ruth Hansen*, Edward Longerich and Mary Longerich****

Motor reeducation of children affected by cerebral palsy is accomplished by training in movement and relaxation. The direct aim of such motor reeducation is to establish or reestablish the function in those muscles and joints which, because of impairment of brain cells, do not have the ability to perform normally.

In the case of the cerebral palsied child whose speech is defective, not only is this motor reeducation of bodily muscles and joints necessary, it is also a basic part of the intensive speech therapy indicated.

Basically there are no speech structures *per se*, for those organs utilized for speech are primarily for biological purposes. For example, the lungs are designed for breathing; the mouth for ingress of food; the tongue and cheek muscles for forming the food bolus; the teeth and tongue for mastication, and the larynx to serve as a valve for closing the air passage and providing for abdominal press.

Although there may be impairment of the motor innervations of these organs, they still may be able to carry on their biological functions. A speech-handicapped cerebral palsied child may be able to chew and swallow his food adequately; yet the damaged brain cells may prevent him from having necessary coordination in movements for speech production. It frequently happens also that the functions of chewing and swallowing are impaired. With such a patient there is need for muscle reeducation and speech therapy to be administered concurrently.

With this view in mind, a study was made in 1945-1946 at the Speech Clinic of the Orthopaedic Hospital of Los Angeles. The aim was to determine an existence of a positive relationship between muscle reeducation and speech therapy; also to show the essential differences in approach to the two principal types of cerebral palsy—athetosis and spasticity.

The work was done with two cases representing these two types. Though no broad generalizations can be made from results in so few cases, they may be considered as indicative for future study.

In general there is much confusion regarding cerebral palsy and the procedures and methods of its rehabilitation processes. Therefore, it is felt that this contribution, though small, may be of value to those interested in the speech and other rehabilitation of individuals with cerebral injuries.

Cerebral palsy is a disturbance of the function of motion, caused by (1) congenital conditions,*** or (2) damage to the brain cells by trauma, asphyxia or infection.[1] Effects produce two major forms of defect in motion.[2] Athetosis, comprising about 45 per cent of all cerebral palsies in children, is a form of involuntary motion, while spasticity, accounting for about 40 per cent of the group, is essentially a muscle stiffness. This inflexibility in the spastic muscle occurs whenever it is stretched. Both forms may be mild, moderate or severe in degree; also both may be of wide extent or may involve but a few joint motions or muscles.

Accompanying athetosis, voluntary tension frequently is found. This is an habitual self-initiated method of attempting to control the involuntary motion. Often it becomes an ingrained habit to the extent that the individual is neither conscious of nor able to lessen it without prolonged training.

Concerning speech in athetosis Phelps says, " . . . there is involuntary motion present either in the diaphragm, breathing mechanism, larynx, tongue, lips or any combination of these. Obviously the same underlying method used for arms and legs must be used for speech, and the tension be entirely eliminated. . . . "[3]

In regard to spastic speech, it also is stated that the retraining of speech muscles is done according to the same principles as in gait or arm function.[3]

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***Named in order of importance—congential causes, according to Ford, comprising about 94%.

When the atypical speech of a cerebral palsied child is caused by aphasia or mental deficiency, both of which may result from the original cause, the above principles do not apply except as motions may be affected in addition to these underlying causes.

Respiratory muscles often are affected in cerebral palsy. In this case, because of environmental reasons, the physical therapist may be able to attack the functional problem of the training of breathing with more ease than the speech therapist. The former customarily works in a situation which requires the removal of the child's clothing. Thus she is in a position to observe more closely the action of the diaphragm and of the abdominal and chest muscles. In so doing she is able to note details which cannot be observed while the child is fully dressed.

Before any correction of certain types of the disturbed breathing coordination can be accomplished by either therapist, the basic malcondition as well as the machinery of normal respiration must be understood.

The mechanically incorrect respiration in cerebral palsied children which is perhaps most difficult to correct is that spoken of by Phelps as "reverse breathing."[4] The incorrect coordination is an attempt to inhale with chest muscles while using the diaphragm and abdominal muscles as though exhaling, and vice versa. Thus sometimes the attempt to speak is being made on partial inhalation. Froeschels apparently speaks of the same condition when he says:

> "The abdominal wall may show movements opposite in phase to the movements of the thoracic wall, which indicates that diaphragmatic respiratory movements are not congruent to those of the ribs. . . . Waste of air will frequently result in insufficient breath pressure for producing continuous speech. This factor will be specially harmful to explosive sounds, but also to all other sounds and will, of course, influence their loudness."[5]

In diaphragmatic respiration of ordinary depth and rhythm, the diaphragm, abdominal and two groups of thoracic muscles participate.[6] Muscles can exert a pull in one direction only. Therefore, the diaphragm contracts as one group of intercostal muscles lifts the rib cage, both causing inhalation. The abdominal muscles then contract forcing the relaxed diaphragm upward, as the second group of intercostal muscles depresses the rib cage, both producing exhalation. In reverse breathing the opposite happens. Thus sometimes when a child is ready to speak no sound is produced because there is no air stream to activate the vocal cords.

Reverse breathing is an example of the need for the coordination of muscle reeducation and speech therapy in rehabilitation of those handicapped by cerebral palsy.

Another possible means of close cooperation between the physical therapist and the speech therapist[7] is that the former may be able to give information regarding relaxation ability, fatigue tolerance, general physical ability or specific motions or activities which she has observed in the patient.

It frequently is possible to facilitate the teaching of certain sounds or words by the use of big movements which accompany the effort to make the sound. This may be accomplished by arms, as in forming the shape of the sounds "ō" or "ah" as they are vocalized. It is of interest to note that this principle was being used at the Los Angeles Orthopaedic Hospital in 1922. Lowman has stated, "We feel that there is a decided advantage in associating certain arm movements with words which assist in conveying an idea, and words or sounds coupled first with gestures are apt to be more easily spoken or attempted."[8] Such movements can be worked into the physical therapy routine.

Another very important factor in cooperation is that of overflow control by relaxation. This is first learned in the muscle training period, then applied in the speech therapy. It prevents the overflow of wrong nerve impulses into arm, leg or trunk muscles from speech effort, and vice versa. Thus better relaxation throughout the body during speech can be maintained.

In muscle reeducation of the cerebral palsied child there are essentially three chief therapeutic agents as named by Phelps: relaxation, movement and massage. The last is used only occasionally on isolated weak or flaccid muscles, and for purposes of the present study is unimportant. Orthopedic methods and other devices as approved by the physician are considered as aids to these two modalities.

Progressive relaxation is a method of gaining relaxation or eliminating tension throughout the voluntary muscles.[9] Relaxation is defined by Jacobson as the absence of all muscle contraction. In this method the individual progressively achieves such willed absence of contraction in first one group of muscles, then another, throughout the entire musculature. The individual also progresses from a lesser to a greater degree of relaxation in each muscle group, thus gradually reducing or eliminating residual tension, the muscular contractions that persist after he is conscious of no further tension.[9] This method of

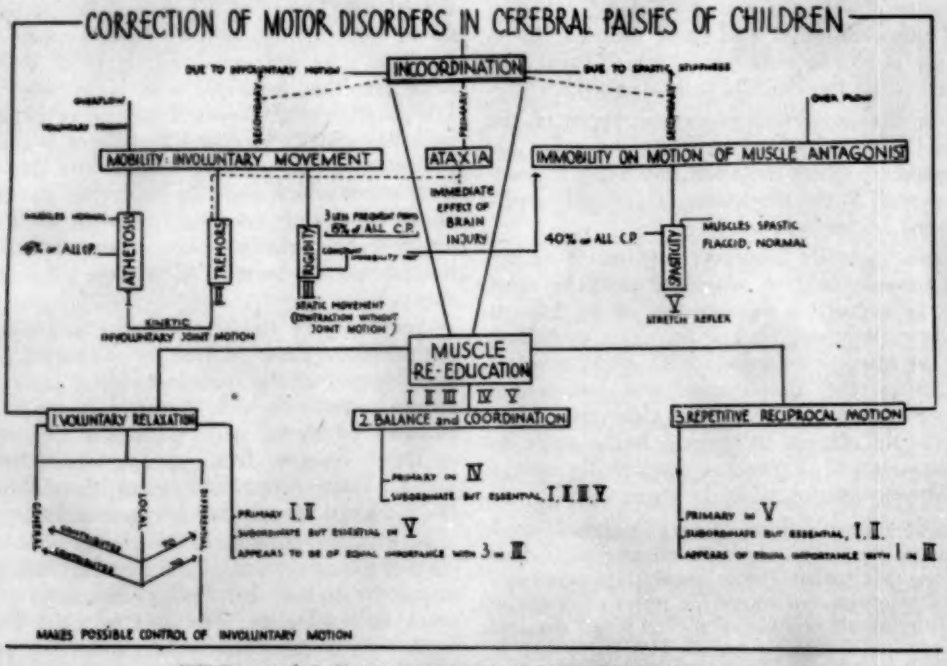
relaxation training, adapted, has been found to be successful, especially in the athetoid type of cerebral palsy.

Certain forms of passive relaxation are used with some individuals who because of early age or other reasons cannot respond well to the above method. These include passive rolling of the head from side to side; gently shaking, swinging or rolling the arms and legs; lifting and dropping a body part, or any other passive movement by the therapist. These movements are usually done from the supine position, but any relaxed position may be used. The use of the imagination to produce a sensory image of some familiar experienced object or situation suggesting a state of relaxation has been found to be effective. These images may be visual, auditory or kinesthetic. Heaviness or inertness as seen in a sleepy kitten, a sleeping baby or as in a handful of sand are examples of such suggestion.

Sometimes a concept of lightness gives the desired effect. Ideas of floating clouds, an empty swing blown by the wind, a drifting feather or autumn leaves falling might be used to stimulate such a feeling. Anything which suggests a gradual "letting go," such as the sinking sun, wavelets running back from shore, or a slow spreading, as the movement of a spoonful of honey dropped upon a flat surface, may be helpful. These concepts of heaviness, lightness, softness, sinking, spreading, "letting go," and others may be used to suggest seeming similar sensations within the body.

In order to gain best results in relaxation training of the cerebral palsied, the therapist must have a clear concept of local, general and differential relaxation.[9] By local relaxation is meant the ability to stop at will all contraction in any voluntary muscle or group of muscles, or in any one part of the body such as the thigh, hand, face or trunk. Skill in local relaxation is essential for the cultivation of general relaxation. By general relaxation is meant the complete willed absence of contraction, simultaneously in all voluntary muscles. This form of relaxation is functional in any situation where rest in reclining position is desired. For the cerebral palsied it is learned in the lying position found to be most comfortable.

Differential relaxation, ideally, is the absence of surplus tension in the performing muscle plus the application of learned local relaxation in all nonworking muscles during any activity.[9] In oral speech it is the absence of contraction in all of the body musculature not used in producing speech—that is, all muscles except those of respiration, phonation, articulation, and weight-bearing.



SPECIFIC MUSCLE TRAINING PRINCIPLES BASED ON DIFFERENTIAL DIAGNOSIS

(Note: Roman numeral "IV" should appear in center of chart under heading "Ataxia.")

Voluntary relaxation is accomplished by progressive training of the kinesthetic sense. By such training the opposite sensations of contraction and relaxation may be immediately recognized and controlled according to need.

Jacobson states that mental stress lessens as muscular tension decreases.[9] This is especially important in speech correction.

General and differential relaxation then are seen to be gained through the use of local relaxation. First in therapeutic importance for athetosis is general relaxation.[10] It may be thought of as "specific" treatment in a similar way to which quinine is known to be a "specific" for malaria. The reason is found in the fact that in the involuntary motion forms, normal movement ability has not been damaged; therefore, it need not be built up. Ability for all motions is present but the patient is unable to make it function because of the interference of (1) superimposed involuntary motion, (2) his own voluntary tension which he uses to block the involuntary motion, (3) overflow. When these are reduced by relaxation training or, in the case of tension or overflow, possibly eliminated, muscles have freedom to function with ability already present.

Differential relaxation would mean in the athetoid that he has learned to localize sensations and reduce the effects of tension in nonworking muscles producing the involuntary motion or the overflow, or in those in which he has been using tension to stop this motion. In the same muscles he has learned to localize the opposite sensations of relaxation and substitute them for the former. In athetosis it has been found that the patient can diminish the range of involuntary motions in varying degrees, sometimes almost wholly, depending upon severity of involvement, concentration ability of the patient and other factors.

Movement is first in therapeutic significance for the spastic type.[10] Repetition of motion may be thought of in spasticity as a "specific." Used reciprocally as an exercise alternating between flexors and extensors or other pairs of muscle groups opposing each other, it is a fundamental agent for restoring or building up the automatic function of gait and use of arms and hands.[4] In the speech muscles the same is true. Examples are found in alternate arm swinging and foot placing in walking and in the constant opening and closing of the jaw and lips and in the successive, alternate tongue positions used in speech.

Local relaxation is inherent in normal reciprocal joint motion. For example, in the pair of motions in the knee—flexion and extension —the flexors must "let go" or relax in order to allow the knee to extend or straighten, and vice versa. This is the function interfered with by the stretch reflex, the consistently characteristic symptom of the spastic muscle. Each time the physical therapist slowly bends or straightens the knee joint, or later as the patient himself performs the motion, the extensors or flexors must relax. At first this must be passive, later being done by the patient.[4] This is true in all muscles performing reciprocal normal joint motions. Muscles which swing the arm or leg forward must relax to allow their antagonists to move them backward. Muscles which perform inhalations in respiration must relax in order to allow functioning of those which exhale. Those which move the tongue to the right must relax to allow others to move it to the left. Success in management of muscle reeducation of voluntary muscle functions in the true spastic appears to be in direct proportion to the observance of the above principle.

We find then that to gain differential relaxation in the spastic certain principles must be observed. Without these the method of concious cultivation of relaxation, successful in the normal musculature, cannot be accomplished. In contrast to training in athetosis, in spasticity the "specific" is repetitive, graded, reciprocal motion (1) to build correct patterns of movement in speech, walking and arm function, (2) to develop normal speed by diminishing the stretch reflex and (3) to strengthen weak muscles. The nearer movement approaches to normal speed and rhythm, the more possible will become the conscious use of differential relaxation or the absence of contraction in all muscles which should not formally function in performing a given activity.

The lessening of the stretch reflex in the muscles is specifically the lessening of spasticity. This can be done only if in the process of training the stretch reflex itself is not stimulated. To accomplish this, motion must be started with slow, passive movements of small range, within limitations imposed by the stretch reflex.

Sometimes in the true spastic there is found a mass response (overflow) which appears to be reflex. Many muscles may enter into this response to a stimulus which may have been intended to produce a single movement of one joint only. Performance of the intended motion may cause erroneous contractions of these muscles. This mass response tends to decrease with

repetitive reciprocal motion as does the stretch reflex in the individual muscle.[10] Since speech muscles are subject to the same deviations from the normal and to the same principles of training as other voluntary muscles, it is likely that overflow also may exist in these muscles and that they will respond to the same sort of training.

A general rule that has been observed in successful training in cerebral palsy is that of first gaining control in big movements of hips and shoulders. From these, training progresses to smaller muscles and to finer coordinations.

Until the athetoid has achieved a certain amount of voluntary control through relaxation, favorable results in speech will be hastened by permitting him to remain in the relaxed position during speech therapy. A relaxation chair originally devised by Phelps has been found to be excellent for this purpose.[11] A mirror can be arranged so it can be used overhead with the child in the relaxed position. Although beneficial for the true spastic, this type of relaxation practice has not been found to be a therapeutic requirement.

The final application of all relaxation in the training of speech, gait and arm function in cerebral palsy lies in the gained ability of the patient deliberately to eliminate movement or tension so there is no observable motion from any muscle except those which he is using.

CASE I

Case History:

Cerebral paralysis, athetoid type; male, age 17 years, 3 months; walked at 36 months; other developmental data lacking; no significant birth history or other etiological data. Left handed. Mental retardation; borderline class. Blanton-Stinchfield Articulation Test A, 71/100.[12] Left school at 16, sixth grade.

At seventeen use of hands was not so good as before the patient started to school; it was difficult to pick up objects, to walk and to run. All muscles showed marked incoordination and rigidity. Scissors gait was evidenced. Involuntary motion was present in left shoulder, arm, little finger, and in toes of left foot.

Speech Diagnosis: dysarthria. Scanning rhythm; monotonous pitch; lack of control of facial muscles; involuntary motions of the lips and tongue. Some articulatory errors found to be consistently the same. For example, in attempting to make the "d" sound, the involuntary movement of the tongue caused the patient to assume a dental "d" position (near the upper central incisors). In a similar manner, because of the athetoid movements of the lips, the patient frequently substituted (but not consistently) "m" for "s", "w" for "v", "l" for "s", and "zh" for "z".

Physical Therapy:

Relaxation training was done in the supine position with pillows under the knees. Before any localized training of voluntary relaxation was tried, an attempt was made to give the patient a generalized feeling of relaxation by (1) passive swinging of arms and legs in small horizontal range, (2) passive lifting and shaking of arms and legs, dropping them to remain limp, (3) passive rolling motions of head, (4) repeated directions to make the entire body "soft, softer," etc., to make an arm, a leg, the neck or other part "soft."

Localized relaxation of muscles was taught whenever tension could be located, according to the method of Jacobson, as far as time permitted.

The right side, in which tension was less noticeable, was worked on first. On the left side, especially in the underarm muscles, tension immediately became apparent by the involuntary motions (athetosis) they produced. Tight tendons and muscles were pointed out and voluntary recognition of sensations of relaxation and tension (contraction) were practiced. The same was true throughout the entire left side.

Speech Therapy:

Following the body relaxation exercises by the physical therapist, the patient was given passive relaxation exercises of the jaw* by the speech therapist. This relaxation training was first done by the operator placing his hand under the patient's jaw, and then manipulating it slowly up and down. Directions to the patient were, "Just let the jaw be 'soft'; sense the feel and action of the jaw, as it is being moved; up-down-rest; up-down-rest; up-down-rest."**

After the passive relaxation jaw training, the speech therapist suggested that the patient execute the jaw movements on his own volition. Again the directions to the patient were, "let the jaw be 'soft'; up-down-rest; up-down-rest, etc."

Next, passive relaxation exercises similar to those of the jaw were given for the tongue. The patient was requested to protrude the tongue. Then the therapist allowed it to rest on a small piece of paper toweling held in his hand. The

*These exercises were given while the patient was lying down, supine position. Later they were administered while the patient was sitting up before a mirror.

**In athetosis it is not the large number of repeated acts that count, but those that are performed from the relaxed position.

following directions were given: "Let your tongue be 'soft', as it lies in my hand." Then, in slow rhythmical movements, the therapist moved the tongue up and down. After learning to relax his tongue in this passive manner, the patient was allowed to execute the tongue movements without assistance. Again he was asked to sense the feel and action of the tongue as it was moved.

Next, the passive lip relaxation exercise was taught. Placing the right index finger on the upper lip and left index finger on the lower, the speech therapist gave the directions: "Let the lips be 'soft'; now, open-close-rest; open-close-rest, etc." Then, as with the jaw and tongue exercises, the patient was asked to execute the lip relaxation exercises without the aid of the operator.

Thus by these passive and local relaxation exercises the patient was taught to eliminate tension from these speech musculatures.

Following the lip relaxation exercises, the patient was requested to hum the sound of "m." Directions: "Keep the lips relaxed, and make them 'soft.' Now as you hum the "m," feel the lips tingle." Then he was asked to prolong the hum, and follow it with the long vowels, for example, "mmmā, mmmē, mmmī," etc. During these exercises the patient was continually being reminded to "let go", make the muscles "soft," etc. Then the "m" plus the diphthongs, "ī", "ow", "ō", and "oi" were used; for example, "mmmī", "mmmow", etc.; also, monosyllabic words beginning with "m", such as "my", "man", "me", "may", etc.

Next the labial sounds, "b" and "p", were introduced. First, the therapist placed the fingers on the patient's lips (similar to the lip relaxation exercise) and aided the patient in closing and then opening the lips for the plosive sounds. Next, the rugal ridge sounds ("d", "t", and "n") were given, and last, the velars and fricatives.

The final aim in all of this speech therapy was the maintenance of the differential relaxation while performing the difficult motions of the tongue, lips, jaw, velum and vocal cords.

At the end of the six months of speech therapy a second administering of the Blanton-Stinchfield Articulation Test A revealed the patient to have a score of 86/100—a rise of 15 points over the previous score. In the performance of the examination the patient exhibited a greater control of facial muscles and showed more skill in the movements of the jaw, lips and tongue. Sound substitutions, which he was making at the beginning of his speech therapy, were considerably reduced. Also there was a definite increase in the consistency of making the correct sound, when attempted.

CASE II

Case History:

Female; C. A., 13 years, 7 months; M. A. 10 years, 10 months; I.Q. 80. Spastic quadriplegia; spastic since birth; sat alone at 30 months; talked at 24 months; never walked alone, though stood alone at about 18 months, and walked in parallel bars; lost this ability at about ten years of age. Twenty degree contractures were present in knees and hips with severe "club foot" type contracture of ankles; entire right side severely spastic, with left side moderately spastic.

The patient fed herself, brushed her hair, and was able to do school work as taught by a home teacher at the time she was first seen by the physical therapist. The arms and hands were constantly held in the flexed position. There were no true contractures in the arms, though a considerable amount of tightness in the right wrist flexors and the pronators appeared as contractures. Active motion was present though not functional in all muscles, even slightly in peroneals. There were contractures in the posterior tibialis muscles.

Speech Diagnosis: dysarthria, severe type. Scanning rhythm; spasmodic interruptions in utterance; monotonous pitch; sudden increases and decreases in volume; articulatory errors always the same. Blanton-Stinchfield Articulation Test A, 62/100.

Physical Therapy:

Muscle training in the supine position was done by (1) slow reciprocal motion in rhythm, to hips, knees, shoulders, elbows and wrists; (2) slow, nonreciprocal isolated motions in rhythm to one joint where necessary for strengthening weak muscles; (3) reciprocal motions as above, developing speed as differential relaxation progressed in degree, and (4) combined motions.

All movement was first done in the supine position. As the patient improved in accuracy, range, speed of movement and relaxation, exercises were made progressively more difficult by means of (1) use of sitting position, (2) resistance, and (3) more complex coordinations applied still later as functional activities. Gross movements were always trained first, and in one limb at a time.

Since reciprocal motion is paired, the normal pairs of motions for shoulders, elbows, forearms and wrists were used. There were three paired

motions for the hips and one for the knees. Flexion and extension of hips and knees were used in the same exercise and simultaneously in opposite directions. All other joint motions were done with both arms or both legs and in opposite directions simultaneously.

Nothing which could be designated primarily as relaxation training was taught this patient except the important form of differential relaxation. In this an attempt was constantly made to control all motion from "overflow" into certain leg or arm muscles during voluntary movements.

Speech Therapy:

Immediately after the muscle training, given by the physical therapist, the patient was placed in a wheel chair before a large mirror. A pillow or board was laid across the arms of the chair, and she was directed to keep her arms relaxed while having her speech therapy.

Speech reeducation was introduced first by giving the patient passive relaxation of the jaw (i.e., opening and closing the jaw). The primary motive was for the development of slow, rhythmical, repetitive jaw movements. After the therapist manipulated the jaw in a similar manner to that in Case I, the patient executed the movements alone.

Similarly, exercises for constant opening and closing of the lips were presented; also exercises for the retracting and pursing of the lips. Again the therapist manipulated the particular speech muscles involved; then the patient was motivated to activate the muscles by herself.

Similar exercises for the repetitive motion of the tongue were next presented. Taking hold of the patient's tongue (as in the tongue manipulation exercise mentioned in Case I) the therapist first gave the passive relaxation exercises for constant up and down movements of the tongue; then, repetitive right-left movements; next, right-up-left-down. To motivate the patient to execute the right-up-left-down movements, the therapist suggested that the patient "wipe the ice cream" off her lips. Any such suggestion might help to stimulate the patient to make large broad tongue movements.

(In the development of speech function, first consideration was devoted to the gross, then the finer movements.)

After training of the repetitive movements of the jaw, lips and tongue, vowel sounds were introduced to make the sound of "ō"; for example, the patient was asked to shape her arms in the form of an "o".[8] Then she practiced uttering the sound of "ō", as she formed the "o" with the arm movements. In a similar manner, "ah" (as in "father") was taught by having the patient shape her arms in the oval form of an "ah". Then vowels on the vowel triangle[13] were taught.

In introducing the lip and rugal sounds, the procedure was the same as for Case I.

Prior to the presentation of the velar sounds the patient was given uvular exercises. First, she was asked to yawn. As she yawned, it was suggested that she sense the feel and action of the palatal muscles. Motivation for uvular action was also given by asking the patient to blow bubbles, blow up balloons, blow feathers across the table, blow out a candle, blow up a sack, etc.

Next, the therapist inserted a tongue depressor into the patient's mouth, lightly touching the uvula and asking the patient to raise the uvula upward. After continued practice the patient was then asked to raise and lower the uvula at will. This exercise was given primarily to aid the patient in improvement of voice quality and to help in the elimination of nasality. Following the uvula exercises, the "k", "g" and "ng" were taught.

As the therapist demonstrated the various speech sounds the patient was asked to sense the feel and action of the lips. Finally, after seven months of concurrent speech and physical therapy, the Blanton-Stinchfield Articulation Test A was again given to the patient, resulting score was 90/100 a rise of 28 points over the previous test.

In comparing these cases to a large number of cerebral palsied children, who had been given speech therapy only, the writers concluded that the marked increase in rate of development of speech skills was undoubtedly due to the physical therapy being administered concurrently with the speech therapy.

Although two cerebral palsied speech cases, of course, are too small a number to be considered as sufficient evidence for drawing final conclusions, results indicate there is a need for further study to be made with a large group of cases.

By way of conclusion, the authors feel that with the physical therapist and speech therapist combining their efforts the cerebral palsied speech handicapped child will be in a position to make the most rapid improvement with his logopedics.

Note: That part of the above article by the physical therapist was written under a grant provided by the Aerodynamics Research Corporation of Washington, D. C.

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The Challenge of Physical Therapy

Nila K. Covalt, M.D.

At the present time I know of no profession in the medical field that offers so great a challenge as does physical therapy. It has been said that orthopedics as a specialty was the outgrowth of World War I, and that physical medicine as a specialty is the outgrowth of World War II. You, as physical therapists, have a major part to play in this specialty since you will be carrying out a large per cent of the prescriptions for physical medicine written by the physicians.

World War II has given great impetus to medical rehabilitation—which is the third phase of medicine. We have long had the first and second phases—the first being preventive medicine, the second following Osler's principles of diagnosis and treatment. There we have stopped—and yet many years ago Sir Robert Jones, in an address before the Hunterian Society, said: "The pathetic side of an orthopedic center is the collection of physical disabilities which should never have been. The inspiring fact is that in our own experience, hardly a case is to be found to whom we cannot offer help."

Too long have we neglected or lost sight of this third phase of medical care—medical rehabilitation—which is an integrated program of physical medicine, physical therapy, occupational therapy, corrective physical rehabilitation, prevocational shop retraining, and educational training or retraining. Its purpose is to provide every patient with the physiological, psychological, social and economic adjustments necessary to make him a useful, self-sufficient citizen within his own community.

In this whole program, you are now eligible to become a part and your part is not an isolated one. You have been trained to do physical therapy and to do it well, as such a specialty deserves to be done. As a specialist, you must always remember that you are now a member of a team which must at all times work in cooperation with all the other specialists in the field of medical rehabilitation. The personnel of each department have their special training and their own particular work to do, yet each must be cognizant of the other specialties, and each must integrate its activities in order that the individual patient will receive the utmost benefits.

The definition of physical therapy which most adequately encompasses the entire field is, "The treatment of injury, infection or disease by the use of scientific massage, muscle reeducation and therapeutic exercise assisted by the modalities of heat, light, water and electricity in their appropriate places and properly applied." Physical therapy also is a medium of assisting in making accurate diagnosis and prognosis by the use of such tests as the manual and electrical muscle tests, measurements of joint motion, or by oscillometric or dermatherm tests. From these same tests, accurate scientific records may be kept which are of great value in estimating the results of treatment for the individual patient, and which also may be of tremendous value in evaluating various treatment methods from the standpoint of research.

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Read before the graduating class of physical therapists, Columbia University School of Physical Therapy, August 16, 1946.

The definition of commencement is "beginning" or "origin." Analogous words are: found, organize, or establish.

How apt and appropriate are any of these terms for each of you today as you become members of a long established profession, and with the added impetus of entering the field of physical medicine as it is expanding into the entire field of rehabilitation.

Physical therapy is no longer an aid to orthopedic cases or peripheral nerve injuries or poliomyelitis alone. It is a definitive part of the specific prescription of physical medicine, and physical medicine is the definitive medical care of medical rehabilitation.

Just as certain drugs are used for specific disease conditions, just so are the prescriptions of physical medicine used. Where a drug like digitalis is of value to a heart condition only, I can think of almost no illness or injury where physical medicine and physical therapy cannot help at sometime in the course of treatment. None of us consider it a cure-all, but the scope of the massage, exercise and modalities and tests are such that we are called upon to work with every other department of medicine and surgery.

In our enthusiasm for these forms of treatment, we have to be judicious and careful of all our treatments and remember we are on the team with the first and second phases of medicine, as well as the medical rehabilitation team.

I would like to divide the definition of physical therapy into the following specific duties:

First: A diagnostic testing, painstakingly done, with an accurate recording of each test;

Second: A scientific treatment, carefully applied;

Third: A thoughtful evaluation of each treatment given, asking oneself these questions each time:

(1) Can I prove the results on each individual case?
(2) Why did this patient respond?
(3) Why was there no improvement with that one?
(4) What was the difference in the two cases?

Some of these questions you will be unable to answer by yourself, but a good physical therapist, in addition to having good training, two hands and a powder can, must always have an inquiring mind. This brings us to the fourth duty—which is research.

All of us realize that even with all the knowledge we have had at hand, some of our treatments have had to be empirical. With the impetus of physical medicine as a specialty, we must scientifically prove as many facts and treatment results as possible.

In this research, by constantly watching the slightest detail, by constantly asking "why," you can be of very great help, and each of you has the opportunity to bring a great contribution to the medical field.

Research is a challenge! It takes patience, but it is never dull or stodgy.

Any or all of these four duties may fail if we loose sight of the greatest duty of all—to treat not just the specific injury, but the patient as a *whole man.*

When one patient responds and another does not, even though they have the same illness, sometimes it is possible that the *whole man* was not treated in the case that failed to respond.

To treat the *man* means two or more additional duties for the physical therapist. The first of these has to do with psychosomatic medicine.

Now none of you are leaving here considering yourself psychiatrists or psychologists. I do not believe you ever will, and yet each of you will have some of that work to do. How far you can go in either field depends upon your individual understanding and interest in each individual patient. However, while you are using scientific treatment methods and carrying out each prescription faithfully, you also will have an unequaled opportunity to assist in giving each patient psychiatric and even sociologic care. You are the one who, next to the nurse, usually will be seeing these patients more frequently than anyone else; you probably will spend more time with each patient than anyone else, even the nurse, since her regular duties do not usually take as long to perform as do yours, nor do they give the same opportunity for conversation.

Some people have estimated that seventy per cent of all general medical and surgical cases need psychiatric and sociological care. Even in army hospitals, the number of patients needing this care was high, and it is true in the acute phase of any illness, whether it be surgical or medical.

Perhaps your part in this treatment is only being a good listener to whom the patient feels free to pour out his worries and fears; perhaps you can allay those fears or even advise him; perhaps you can relay them to another member of the team without betraying the confidence and

trust the patient has reposed in you, but at the same time, can get the teammate in, whomever it may be. Maybe the worries are physical, maybe mental, maybe sociological and involve the family, friends or finances, so that several members of the team need to help. Whatever the trouble, you will be in a position where the patient will trust you and look up to you for help in ways that have no particular bearing to the ailment for which you are specifically treating him.

Again, when Sir Robert Jones said, "The inspiring fact is that in our own experience, hardly a case is to be found to whom we cannot offer help," the next duty in treating the *whole man* is defined.

It is not enough to have a beautiful surgical result or to have gone as far as is physically and mechanically possible to correct a disability. If there is any disability left, the man has to be taught how to live with it, not for it. If it is there, how does he get along in spite of it?

Your final responsibility, therefore, is to teach the patient functional activity in addition to his specific therapeutic treatment. He may have to be taught all over again, all the needs of his own daily living, from his own personal physical needs, to dressing himself, to getting about. All the physical, economic and educational training in the world is of no value to this man, if he is not trained how to help himself to use them. Only by being independent will a man have self respect, without which no one can make the proper psychological, social and economic adjustments necessary to live within one's own community.

Let us all never lose sight of teaching those fundamental functional activities, then, even as we take pride in reeducating paralyzed muscles or in loosening up a stiff joint.

All of us have known or heard of cases where it has been said: "Poor dear, she has been bedridden for twenty years," or "He has been in a wheel chair all of his life."

The other day I saw a man who appeared to be about forty years of age, a spina bifida with both legs paralyzed from birth who, up until ten years ago, had crawled about the town, and up and down stairs, but had never stood upright. Nor had any formal schooling been provided for him. Ten years ago some one got braces for him, but no one taught him how to use them. He walked in his own peculiar fashion, but at least he was upright! Over three years ago the braces had broken, and he was reduced to crawling again. This spring he came to the attention of one of the State Societies for Crippled Children and Adults, who ordered him braces. When I saw him, he had been walking just three and a half weeks, and I do not believe I have ever seen any more joy expressed on any face than was on that man's —as he came into the physical therapy clinic. He was avid for more instruction and to perfect himself in the use of his crutches—so avid that it appeared to me the physical therapist was getting as good a work-out as she gave the patient. He is attending a trade school since it has been determined this man has an aptitude for office work. I have no doubt but that he works just as hard there as he did with his crutches.

Case after case of just such situations can be called to mind. Surely in the future, as we all work together, there will be fewer of such case reports, and let us hope that eventually there will be none.

When anyone is ill, they need and demand attention which is more than medical. The family and friends want to help, and they usually appear to enjoy waiting upon a patient. All of us like and need sympathy at times, but if continued too long or continued in the wrong places, it eventually turns into pity. The patient who has had a long illness or is still ill when he goes home has to be reintegrated into a situation where everyone else takes up his own busy living. It takes too much time to wait while the patient laces his shoes with one hand, or too much time to watch him struggle into a wheel chair. In haste, the well meaning family put the shoes on, lift the patient into the chair, or just carry him about in their arms without even bothering with a chair. It's human to let others do the work, and it's easier when one has been ill to let others spare the patient discomfort or to ask him to make an effort; sometimes patients take it as their just due, and not only expect it but develop great self-pity. Actually, they vegetate. The family and friends take the same attitude, so now there are two sets of patients needing psychosomatic medicine—the patient, and all those associated with him. Sometimes the associates are harder to treat than the patient—not that they cannot understand, but again they may be too busy to take the time, or again their misplaced sympathy or pity may have made martyrs of them and they would not feel "right with themselves" if they did not completely care for "poor Johnny."

Both groups of patients will expect and be willing for you to give the physical treatments, even if it hurts the patient; the functional training for both groups of patients may take far more patience, skill, tact and judgment than all the science you know—but without succeeding to develop self-care and self-respect, you and the

other members of the team have failed to make this patient a whole man.

One of the most dramatic examples of this, as well as one of the most dramatic examples of advances in medicine and surgery during World War II, is that of the patients with spinal cord injuries.

In World War I, practically all the patients with such injuries died. The percentage of deaths in our civilian hospitals during the ensuing years has been equally high. World War II has changed the picture and status of these injuries entirely. Twenty-five, twenty, fifteen, ten or even five years ago practically all such patients were doomed to die within two days or two years. Today there are over two thousand patients with spinal cord injuries who are survivors from World War II. Today all of these men are alive, due to new methods of medical and surgical care, but in addition they are being made or have been made into useful citizens who can live out their alloted span of life. That is really a triumph of medicine.

It is also an example of teamwork, starting with the first aid on the battle field, through the first aid stations, back through all the various hospitals, aided and treated at every turn, starting with the first aid man and on with the surgeons, the neurosurgeons, the urologist, the other medical specialists as they were needed, with the addition of the physical therapists, the men in corrective physical rehabilitation, the occupational therapists—all contributing their specific medical care until these men are today able to try out prevocational shop retraining or to resume their education. Some have already completed their training and are already useful citizens in their own communities; others are still in the process of learning, and all of them have this opportunity.

Certainly no more dramatic example of new medicine and methods and teamwork can be found than this, but while this is a dramatic instance, the same procedure can apply to any illness and injury, even though it is not necessarily so serious and though it will not carry with it such a permanent and great disability.

The needs in acute medical and surgical cases from a psychosomatic standpoint were mentioned above. Physically there is a definite place of treatment for the physical therapists with these cases.

When Ansel Keys made his original reports to the National Research Council on the physiology of bed rest, these reports were followed by the reports of Powers and Whipple on the value of early ambulation for surgical cases. Now one report after another is coming into the literature to substantiate this, and no one doubts that early motion and activity is an essential part of treatment with certain exceptions like tuberculosis or cardiac cases.

The physical therapist can go one step farther in this early ambulation program in that she can teach specific exercises to all patients to prevent deformities and to maintain muscle tone, even as the patient is in bed. The physical therapist can teach correct posture, and primarily she can teach the patient how to relax that he may have the proper rest when he needs it—to rest, to relieve pain and to allow the various medicines to take effect more quickly and more easily. The physical therapist and the nurse together can do much to see that lying in bed in itself does not bring on a deformity or disability that has nothing to do with the illness being treated.

There is even a place for certain judicious treatment such as this for patients with tuberculosis as well as for those with cardiac ailments; the medical patient after a long illness such as pneumonia, scarlet fever, typhoid or any other illness may have almost as much need for specific muscle reeducation as the patient with poliomyelitis; the mental patient can be taught relaxation and given posture training; the patient who is to have chest surgery, whether he has tuberculosis or some other chest condition, responds beautifully to certain specific chest exercises.

Thus the treatment of physical medicine and physical therapy goes down the line, and through the entire gamut of medicine and surgery.

I wish to repeat that no profession in the medical field offers so great a challenge today as does physical therapy.

I wish to emphasize also the treatment is for the whole man, and you as physical therapists must treat the whole man and not the disability.

Schools Approved for Training Physical Therapists

By Council on Medical Education and Hospitals of the American Medical Association

Name and Location of School	Medical Director	Technical Director	Entrance Requirements*	Length in Months	Classes Start	Tuition	Certificate, Degree, Diploma
Children's Hospital, Los Angeles[1]	Samuel S. Mathews	Lily H. Graham	a-b-d	14	Sept	$200	Cert. or Degree
College of Medical Evangelists, Los Angeles[1]	F. B. Moor	A. H. Carlson	a-b-c-d	12	Sept	$225	Cert. or Degree
University of Southern California, Los Angeles	O. L. Huddleston	Charlotte .W Anderson	a-b-d[2]	12	Sept	$496	Cert. or Degree
University of California Hospital, San Francisco[1]	Frances Baker	Margery Wagner	d-e	12	Sept	$186[4]	Cert. or Degree
Stanford University, Stanford University, Calif.[1]	Wm. Northway	Lucille Daniels	a-b-d[2]	12	Jan April June Sept	$666.60	Cert. or Degree
Northwestern University Medical School, Chicago	John S. Coulter	Gertrude Beard	a-b-d	12	Oct	$300	Certificate
State University of Iowa Medical School, Iowa City	W. D. Paul	Olive C. Farr	e	12	Sept	$299	Certificate
University of Kansas School of Medicine, Kansas City, Kans.	Donald L. Rose	Lilyan G. Warner	a-b-c[3]	12	Feb Sept	$70[4]	Cert. or Degree
Bouve-Boston School of Physical Education, Boston	Arthur L. Watkins	Constance K. Greene	H.S.	36	Sept	$500 yr.	Degree
Boston University College of Physical Education for Women: Sargent College, Cambridge 38, Mass.	Louis Howard	Adelaide McGarrett.	H.S.	36	Sept	$435 yr.	Cert. or Degree
University of Minnesota, Minneapolis[1]	Miland E. Knapp	Ruby M. Green	H.S.	36	Oct	$530[4]	Degree
Mayo Clinic, Rochester, Minn.	Frank H. Krusen	Ruth Ryan	a-b-c	12	Jan July	None	Certificate
Barnes Hospital, St. Louis	F. H. Ewerhardt	Beatrice F. Schulz	a-b-d	12	Sept	$200	Certificate
St. Louis University School of Nursing, St. Louis[1]	Alexander J. Kotkis	Sr. Mary Imelda	H.S.	36	Jan Sept	$300	Degree
Albany Hospital, Albany, N. Y.	John W. Ghormley	Catherine Graham	a-b-c	12	Sept	$200	Certificate
Columbia University, New York City	Wm. B. Snow	Josephine L. Rathbone	a-b-c	1 or 2 yrs	Sept	$450 yr.	Cert. or Degree
New York University School of Education, New York City[1]	George G. Deaver	Elizabeth C. Addoms	a-b-d	12	Sept	$525	Cert. or Degree
Duke University School of Medicine, Durham, N. C.[1]	Lenox Baker	Helen Kaiser	a-b-d	15	Oct	$300	Certificate
D. T. Watson School of Physical Therapy, Leetsdale, Pa.[1]	Jessie Wright	Kathryn Kelley	a-b-d	12	Oct	$300	Diploma
Graduate Hospital of the University of Pennsylvania, Philadelphia, Pa.[1]	George M. Piersol	Katherine S. Sutherland	a-b-e	12	Sept	$300	Certificate
University of Texas School of Medicine, Galveston	G. W. N. Eggers	Ruby Decker	a-b-d	12	Jan	$143[4]	Certificate
Baruch Center of Physical Medicine of the Medical College of Virginia, Richmond, Va.[1]	Frances Hellebrandt	Josephine Buchanan	a-b-c[3]	12	Sept	$262[4]	Cert. or Degree
University of Wisconsin Medical School, Madison[1]	Harry D. Bouman	Margaret Kohli	a-b-c[3]	12	Sept	$96[4]	Cert. or Degree

*Courses are so arranged that any of the entrance requirements will qualify students for training. a = Graduation from accredited school of nursing; b = Graduation from accredited school of physical education; c = Two years of college with science courses; d = Three years of college with science courses; e = Four years of college; H.S. = High school graduation.

[1]Male students are admitted.

[2]High school graduates accepted for a four-year course leading to A.B. degree; students admitted quarterly and tuition is $166.65 per quarter.

[3]High school graduates accepted for four-year college course.

[4]Nonresidents charged additional fee.

The Physiotherapy Review

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We are constantly being reminded that physical therapy is a young profession and that the possibilities for its growth are tremendous and unpredictable. We feel a great pride in being a part of this pioneering group. But with this pride must go a full realization of our responsibilities for nurturing this growth and guiding it in the right direction. To properly deserve a share in this progress we must help in two ways: first, read and study about new trends, and second, contribute new material so that it may be available to all who are interested.

The growth of our profession was accelerated by World War II and the problems of medical care stimulated the use of new devices and technics for physical treatment. Large numbers of patients under continuous hospitalization made some types of treatment possible which under ordinary civilian circumstances would be impractical. Similar conditions today in the Veterans' Administration are a contributing factor to further development. The intense interest of the physical therapists has been the most important factor in establishing these new ideas. Some of the recent material we have received from these sources includes exercises for chest conditions, bed exercises, care of amputees, and increased stress in complete rehabilitation of the patient. There also has been much research in progress in universities and hospitals throughout the country. As this material is made available for reading and studying it is our responsibility to become familiar with it and to make application of it in our work.

Our second responsibility is to give the new things we develop to the rest of our profession and to those allied with it. In the process of improving one's technics of treatment one frequently discovers new and more effective means. In such cases one should do enough research to make it valuable and then present it to others. Material of this type should be offered and used for meetings and publication.

The standards of physical therapy will be determined largely by those within the profession. The opportunities for development are still unlimited. We should each take an active part in that process if we wish to share the benefits.

Correction

Through error, the name of Mrs. Alberta I. Gabelman, 1821 South Pollard St., Arlington, Va., was omitted from the "Directory of Members (American Physiotherapy Association) 1946" as published in our January-February 1947 issue.

American Congress of Physical Medicine

The American Congress of Physical Medicine will hold its twenty-fifth annual scientific and clinical session Sept. 2, 3, 4, 5 and 6 inclusive, at the Hotel Radisson, Minneapolis. Scientific and clinical sessions will be given the days of Sept. 3, 4, 5 and 6. All sessions will be open to members of the medical profession in good standing with the American Medical Association. In addition to the scientific sessions, the annual instruction courses will be held Sept. 2, 3, 4 and 5. These courses will be open to physicians and the therapists registered with the American Registry of Physical Therapy Technicians. For information concerning the convention and the instruction course, address the American Congress of Physical Medicine, 30 North Michigan Avenue, Chicago 2, Illinois.

American Occupational Therapy Association

The American Occupational Therapy Association is holding their national convention October 31 to November 7, 1947, at the beautiful Hotel Del Coronado across the bay from San Diego in California. It is the 30th anniversary of the Association and plans are being made to have the biggest and best convention ever.

New Division of Special Education

Indiana State Teachers College, Terre Haute, Indiana, has opened a new "Division of Special Education," charged with a three-fold function: (1) the training of teachers, supervisors and administrators of special classes and special education divisions for public school systems, and for state schools for the seriously handicapped; (2) the training of nonmedical technicians and consultants (professional personnel other than teachers) who contribute to the education of exceptional children, and (3) the dispensation of clinical services to children and adults (both on and off campus) who have academic, psychological or sensory perception problems, or who are in need of vocational counseling for placement or adjustment.

Special Courses in Speech and Hearing Therapy

Western Reserve University and the Cleveland Hearing and Speech Center announce special courses in hearing and speech therapy for the summer session beginning June 25 and ending July 31, 1947, as follows:

1. "Speech Correction for the Orthopedically Handicapped" will be given by Miss Ruth Lundin, Supervisor of Speech Correction at Cleveland Rehabilitation Center and Instructor at Western Reserve University. The course will orient physical and occupational therapists and speech teachers in organization, procedures and problems related to the orthopedically handicapped.

2. Courses in "Speech Correction for Teachers" and "Clinical Technics in Speech Therapy" will be given by Miss Thelma Knudsen, Supervisor of Speech Correction at South Bend, Indiana, Public Schools. Mrs. Amy Bishop Chapin, Assistant Director of Clinical Services at the Center, will give "Clinical Practice in Speech Therapy".

3. Dr. Rachel Dawes Davies will give courses in teaching speech to the deaf, language arts, and will supervise practice teaching in these courses. Miss Alice Burtnett, lip reading teacher from Youngstown Public Schools, will give lip reading for the hard of hearing.

4. Courses in hearing will consist of "Hearing Conservation, including anatomy, case finding and educational adjustments", and "Audiometry and Hearing Aids". The latter course will be practical and theoretical and is open to anyone who is eligible for admission to a college. Dr. Warren H. Gardner, Director of Clinical Services, will direct this program, aided by Miss Dorothy Ayers, Acoustic Technician from the Borden General Hospital. Dr. Charles Kinney, otologist for Cleveland Public Schools, and other specialists will lecture.

5. A demonstration class in teaching speech to very young deaf children will be given by Miss Ruth Bender, Instructor at Western Reserve University and teacher at East Cleveland Day School for the Deaf.

6. The Cleveland Hearing and Speech Center also is accepting applications for training for executive secretaries of hearing societies. Courses in social administration, social case work, and recreation, as well as basic courses in hearing and speech therapy will be offered applicants.

Ohio Chapter

The Ohio Chapter of the American Physiotherapy Association held its eleventh annual meeting at the Tudor Arms Hotel, Cleveland, Ohio, May 9 and 10, 1947, with a program as follows:

Friday, May 9

1:45 p. m. Remarks, Mrs. Daisy H. Houpt, Chairman, Cleveland District
Mrs. Catherine McQuaid, Presiding
"Treatment of Scoliosis"
J. I. Kendrick, M.D., Orthopedic Dept., Cleveland Clinic

2:40 p. m. "Medical Aspects of Rheumatoid Arthritis"
Robert M. Stecher, M.D., Assistant Clinical Professor, Western Reserve University; Visiting Physician, General Medicine, Cleveland City Hospital; Director, Fever Therapy Arthritic Clinic, Cleveland City Hospital

6:45 p. m. Dinner,
In honor 25th Anniversary Cleveland District
Mrs. Margaret Cleaveland, Presiding
"Experiences in Greece"
Miss Helen Kaiser, Technical Director, Dept. of Physical Medicine, Duke University, Durham, N. C.

Saturday, May 10

9:30 a. m. Mrs. Daisy H. Houpt, Presiding
"Physical Medicine in Peripheral Vascular Disease"
Walter M. Zeiter, M.D., Director of Physical Medicine, Cleveland Clinic

10:45 a. m. "Prefrontal Lobotomy"
Harry A. Lipson, M.D., Instructor, Neurology and Psychology, Western Reserve University; Visiting Neuropsychiatrist, Cleveland City Hospital; Director, Out-patient Clinic, Cleveland State Hospital

11:00 a. m. "Orthopedic Aspects of the Treatment of Rheumatoid Arthritis"
George S. Phalen, M.D., Orthopedic Dept., Cleveland Clinic

12:30 p. m. Luncheon
Miss Emmy Kylin, presiding
"Ethics"
Miss Enid Fifield, Physical Therapist Condon School, Cincinnati, Ohio

Infantile Paralysis — 1947:

Physical therapists who can be released to serve for a month, six weeks or longer in an epidemic area this summer are asked to write directly to Catherine Worthingham, National Foundation for Infantile Paralysis, 120 Broadway, New York 5, N. Y. Please give dates when you can be called upon, together with present employment and experience in order that your services can be used to the best possible advantage.

Twenty-Fourth Annual Conference

American Physiotherapy Association

Asilomar, Pacific Grove, California—July 6 to 12, 1947

Program Schedule

	Sunday July 6	*Monday July 7*	*Tuesday July 8*	*Wednesday July 9*	*Thursday July 10*	*Friday July 11*	*Saturday July 12*
8:30 a.m.		House of Delegates and General Session Address: Sue Roen, President Annual Reports to Membership Election of Officers of House of Delegates	James B. Mennel, M.D. "Massage"	FUNCTIONAL ANATOMY: Chairman, Lucille Daniels Verne T. Inman, M.D. Prof. of Anatomy, Univ. of Calif. "Functional Anatomy of the Lower Extremity"	Verne T. Inman, M.D. "Functional Anatomy of the Lower Extremity"	Verne T. Inman, M.D. "Functional Anatomy of the Lower Extremity"	9:00 A. M. James B. Mennell, M.D. "Phases of Therapeutic Exercise"
10:30 a.m.			House of Delegates and General Session	Irving Rehman, Ph.D., Asst. Prof. of Anatomy, Univ. of Southern Calif. "Normal Joint Motions of the Lower Extremity"	Chas. L. Lowman, M.D., Chief of Staff, Orthopaedic Hospital, Los Angeles "Correction of Gluteus Medius Limp"	Signe Brunnstrom, M.A., A.P.A. "Gait Training Procedures"	11:00 A. M. Discussion period
12:30 p.m.	Luncheon						
2:00 p.m.	Registration* P.T. Schools Section	REHABILITATION: Chairman, Hazel Furscott History of Rehabilitation Relation of Medical Service to Rehabilitation Services Mental Hygiene in Relation to Rehabilitation Testing Procedures	*Physical Therapy Technics in Rehabilitation* Physical Demands of Daily Life Group Exercises and Games as Therapeutic Treatment Physical Therapy Procedures in Preoperative and Postoperative Care of Chest Surgery Patients Early Bed Exercises Demonstrations of Remedial Exercise	*Correlated Fields* Occupational Therapy Rehabilitation Placement of the Handicapped Vocational Rehabilitation Services	Tours of the Monterey Peninsula Arranged by Northern California Chapter	House of Delegates and General Session	
5:00 p.m.	Exhibits	Exhibits	Exhibits	Exhibits	Barbecue Supper	Exhibits	
6:00 p.m.	Dinner						
7:30 p.m.	P.T. Schools Section	Meetings of National and Chapter Standing Committee Chairmen: Education Legislation Relations		House of Delegates and General Session	Entertainment	House of Delegates and General Session	

*Registration fee: Members, $5.00; nonmembers, $10.00; students, $2.00.

RESERVATIONS FOR CONFERENCE

The Twenty-Fourth Annual Conference of the American Physiotherapy Association to be held at Asilomar, Pacific Grove, California, July 6 to 12, 1947, is being considered a six-day meeting. When sending reservations to the National Office, make your payment on the basis of *six days* for the entire conference period.

Welcome to Asilomar

The Northern California Chapter joins with all California members in welcoming you to the conference next July. We are sure you will be more than pleased with Asilomar and the Monterey Peninsula. If you have already been to this spot you know how beautiful it is. If you have

not, mere words are inadequate to describe it here so we will not try but cordially invite you to come see for yourselves. We are planning to help give you as much of a taste of the western scene as time will permit. Come sample our western hospitality at first hand.

Workshop in Therapeutic Exercise

James B. Mennell, M.D., from London, author of numerous textbooks on physical therapy, will be a special lecturer on the program of the Workshop in Therapeutic Exercise at Stanford University, July 14 to August 2, 1947.

For veterans attending the Workshop, the tuition or auditor fee will be paid according to the provisions of the G.I. Bill. Full maintenance based on the regular subsistence rate will be available for the three week period.

For further information on the Workshop, refer to your March-April 1947 issue of the REVIEW.

Postgraduate Course in Physical Medicine, University of Texas

Barbara White, Executive Secretary of the American Physiotherapy Association, attended the very successful four and a half day postgraduate course in physical medicine offered at the University of Texas Medical Branch, Galveston, Texas, March 3-7, 1947. The course was designed to help physicians in general practice and in the medical specialties to use physical medicine more effectively. Although the course was planned primarily for physicians, physical therapists were cordially invited.

The faculty for the course consisted of Lt. Bearz, West Point; Dr. Bennett, Warm Springs; Dr. Donald Covalt, Washington, D. C.; Dr. Elkins, Mayo Clinic; Mr. Holmquist, Chicago; Dr. Kovacs, New York; Major Kuitert, Denver; Dr. Landauer, New York; Dr. Martin, Kansas; Dr. Ober, Boston; Dr. Piersol, Pennsylvania; Dr. Watkins, Boston; Dr. Boynton, Texas; Mr. Brown, Texas; Dr. Selke, Texas; and members of the faculty of the University of Texas—Medical Branch.

Over 150 were registered for the course; 35 states were represented. At a luncheon meeting of American Physiotherapy Association members, ten chapters were represented.

Much credit is due to the work of Dr. W. A. Selle, Professor of Physiology, and Chairman of the Postgraduate Course in Physical Medicine, and Dr. Chauncey Leake, Dean of the Medical School, for the success of the program. Plans for a similar course are already under way for early March next year. Watch for announcements in the REVIEW and plan to attend. The week was most enjoyable, professionally and socially.

New Members

The following are newly accepted members of the American Physiotherapy Association:

Brook, (Miss) Ora L., U. S. Naval Hospital, Long Beach, Calif.
Bruitt, Evelyn, White Memorial Hosp., 312 N. Boyle, Los Angeles 33, Calif.
Burnet, Ruth E., 2144 S. Norfolk Terrace, Tulsa 5, Okla.
Cady, Karl F., 213 San Bernardino St., Lomda Linda, Calif.
Chabala, Lillian E., 1135 Avoca Ave., Pasadena, Calif.
Counihan, Robert H., 135-23 122nd St., Ozone Park, New York 16, N. Y.
Earle, Marjorie Pearce, 1201 First St. S. W., Rochester, Minn.
Easterly, L. R., Delaware State College, Dover, Del.
Fritz, Mary L., 15 - 12th Ave., N.W., Rochester, Minn.
Ganson, S. Evelyn, 1816 Pacific Ave., San Francisco 9, Calif.
Giannone, Elvira M., 60 Henderson St., Paterson, N. J.
Gutekunst, Mrs. Ethel, 1941¼ New Jersey, Los Angeles 33, Calif.
Hawkins, Mrs. Helen Elizabeth, 539 Padilla St., San Gabriel, Calif.
Hunt, James E., 1222 Laurel Ave., St. Paul 4, Minn.
Kline, Christine K., c/o Hendricks, Coal Valley, Pa.
Legler, Martha, 1345 W. Campus Road, Lawrence, Kans.
Levy, Marilyn M., 1620 Cadiz St., New Orleans, La.
Masters, Dorothy G., Huntington Mem. Hosp., Pasadena, Calif.
Mishou, Shirley Ann, Maine Hotel, Pueblo, Colo.
Monacelli, Levia V., 348 W. Academy St., Albian, N. Y.
Moore, Lester J., 206 S. Boyle Ave., Los Angeles 33, Calif.
Morgenstern, Mary Ann, 1241 Bush St., Apt. 101, San Francisco, Calif.
Nichols, Mrs. Margaret, 1316 Third, Corpus Christi, Tex.
Ogg, H. Lorraine, 10615 Ayres Ave., West Los Angeles 34, Calif.
Okamoto, Sophie T., 210 Sixth St. S.W., Rochester, Minn.
Raths, Katherine, Wadsworth, Kans.
Selvin, Dinah M., Halloran Vets. Adm. Hospital, Staten Island, New York, N. Y.
Sister M. Leonard Catherine, St. Eliz. Hosp., 736 Cambridge St., Brighton, Mass.
Stohl, Marilynn J., 750 N. Martel Ave., Hollywood 46, Calif.
Stowell, Elaine, 1201 First St. S.W., Rochester, Minn.
Summers, Ida May, Route 11, Box 363, Birmingham 10, Ala.
Tease, Marjorie G., 468 6th Ave., New York 11, N. Y.
Thompson, S. Elizabeth, 3252 Kenwood Ave., Indianapolis, Ind.
Titus, Ann Glorene, 4112 Francis, Kansas City, Kans.
Van Buskirk, Sarah, 2144 S. Norfolk Terrace, Tulsa, Okla.
Voss, Dorothy I., 1334 Pennsylvania Ave., Los Angeles 33, Calif.
Watkins, Marguerite, 1225 Clifton Road N. E., Atlanta, Ga.
Wiggins, Alice E., Douglas Co. Hosp., Omaha, Nebr.

Recent graduates of Stanford University, Calif.:

Amster, Mary Faye
Bogart, Virginia Ann
Henry, Mrs. Louise H.
Hollingsworth, Audrey
Salamon, Jeanne S.
Smith, Sylvia M.
Summerhays, Catherine L.
Turnquist, E. Joan
Woods, Juanita Ione

Recent graduates from Boston University, College of Physical Education for Women, Sargent College, Cambridge, Mass.:

Alkins, Margaret Eleanor
Anderson, Tina E.
Bartlett, Patricia Ann
Bertolet, Mary Louise
Bullard, Agnes Jean
Caplan, Barbara
Cushing, Florence S.
Doda, Teresa
Eisner, Mrs. Arlene
Eldridge, Martha
Gordon, Selma
Green, Shirley
Gustafson, Shirley I.
Holman, Margaret C.
Johnson, Phyllis
Kimball, Betty Carleton
Lathrop, Margaret G.
Wadsworth, Elizabeth
Walther, Doris Esther
Wheelwright, Elizabeth B.
Zand, H. Elizabeth

Recent graduates of New York University School of Education, New York, N. Y.:

Hommas, H. Norman
Kinnard, Charles M.
Lowe, Phillip

Recent graduates of St. Louis University School of Nursing, St. Louis, Mo.:

Flynn, Anne K.
Quinn, Patricia C.

Public Law No. 36

The Bill, establishing in the Regular Army an Army Nurse Corps and a Women's Medical Specialist Corps, composed of a Dietitian Section, a Physical Therapist Section, and an Occupational Therapist Section, was signed by President Harry S. Truman on April 16, 1947. It is known as Public Law No. 36.

Attending the ceremony were Major General Norman T. Kirk, The Surgeon General of the Army; Colonel Florence A. Blanchfield, Superintendent of the Army Nurse Corps; Major Emma E. Vogel, Director of Physical Therapists, and Major Helen C. Burns, Director of Dietitians. Rear Admiral C. A. Swanson, The Surgeon General, U. S. Navy, and Lt. Commander Ruth B. Dunbar, Assistant to the Superintendent of the Navy Nurse Corps, represented the United States Navy.

Women's Medical Specialist Corps

Public Law 36 (80th Congress) signed by the President on April 16, 1947, authorizes a permanent Women's Medical Specialist Corps comprised of a Dietitian Section, a Physical Therapist Section, and an Occupational Therapist Section in the Medical Department of the Regular Army.

Requirements for Integration Appointments:

An applicant must have passed the age of 21, be a female citizen of the United States, have served honorably on active duty at any time since December 7, 1941, as a commissioned officer in the Army of the United States as a physical therapist. She must be unmarried and have no dependents under 14 years of age.

Grade:

Initial integration appointments of eligible applicants will be made in the grades of second lieutenant, first lieutenant, and captain. Applicants appointed who have had less than three years constructive or active Federal military service, whichever is the greater, will be appointed as second lieutenants. Applicants appointed who have had over three years, but less than ten years of constructive service will be appointed as first lieutenants. Applicants appointed who have over ten years of constructive service will be appointed in the grade of captain.

Constructive Service:

Constructive Service credit is computed by the number of years, months and days by which an applicant's age on date of appointment exceeds a specified base age which has not yet been determined by the War Department. In computing the period of service, each officer honorably discharged or separated from the military service subsequent to May 12, 1945, also shall be credited with the period from the date of her separation to the date of her appointment.

Pay and Allowances:

The pay and allowances will be the same as for all other commissioned officers.

The base pay for officers in the grade of second lieutenant, first lieutenant, and captain, with less than three years of service, is $180, $200, and $230 per month, respectively, with five per cent increase of base pay for each three years of service, plus $.70 per diem for subsistence. Physical therapists assigned to hospitals for duty are usually provided quarters. When quarters are not available, the money allowance for rental of quarters is the same as for other officers.

Promotion:

Promotion will be the same as for other commissioned officers.

Retirement:

Physical therapists in the grades of second and first lieutenant and captain may be retired at the age of 50 years at 2½ per cent of their base and longevity pay multiplied by their years of service, or they may elect to retire after 20 years of service, regardless of age, and receive 2½ per cent of their base and longevity pay multiplied by their years of service. Regardless of years of service completed, physical therapists below the grade of major may be retired at the age of 50. Those in the grade of major may be retired at the age of 55.

Assignment:

Physical therapists will be assigned in accordance with military needs.

Educational Opportunities:

If funds are available, it is anticipated that training facilities will be available to a limited number of officers in this Corps.

Term of Service:

A physical therapist who is commissioned in the Women's Medical Specialist Corps is commissioned for life. However, she may resign her commission under provisions approved by the Secretary of War.

Reserve Corps:

Additional personnel needed over and above the total minimum authorized strength authorized for the Regular Army to fulfill the needs of the anticipated strength of the interim Army will be met by the appointment of qualified reserve physical therapists who, with their consent, will serve on extended active duty for such period of time as may be determined by the Secretary of War.

1. Appointment may be made in grades of second lieutenant to and including captain.
2. Age 21-44, inclusive.
3. Female officers appointed after June 22, 1944, and honorably separated thereafter, may, if otherwise qualified, be appointed in the highest grade held on active service before reporting to a separation center.
4. Appointment in the Reserve Corps will be for a period of five years with privilege of renewal.

Application Blanks:

Application blanks may be obtained from the Office of The Surgeon General, U.S. Army, Washington 25, D.C., Attention: Physical Therapy Branch, or from the national office of the American Physiotherapy Association.

War Department Manual

The Surgeon General announces that War Department Technical Manual 8-293 "Physical Therapy for Lower Extremity Amputees" is now available for purchase from The United States Government Printing Office, Washington 25, D. C., cost—twenty cents (20c) per copy. Communications should be addressed to The Superintendent of Public Documents.

Physical Therapy Near Manila

The following interesting description was taken from a letter received by Major Emma E. Vogel,

Director of Physical Therapists, U. S. Army, from 1st Lt. Carol Stange, Medical Department Physical Therapist, now assigned to the 10th General Hospital, near Manila in the Philippine Islands.

One of our very special patients is a one-month-old baby with a spina bifida, at the level of about L-2-3-4. The baby has no sensation or motion in her lower extremities. She had two club feet—I say *had* because since we've been working on them they seem almost normal. When the baby was born, the dorsa of both feet were folded back against the anterior surfaces of the tibiae. At first, padded tongue depressors with arches were bandaged on her feet, while wedges of felt were placed between the dorsa of the feet and anterior surfaces of the tibiae. The tongue depressors did not provide adequate support, so with the help of our brace man, I made metal shoes with built-in arches padded with felt and thicker wedges of felt for the dorsum. Casts could not be applied because of the sensory disturbances. The little shoes are removed once a day for about half an hour for massage and exercise, which consists mostly of correction of the deformity. Just last week, motion in the right quadriceps was discovered. I am not too sure that the contraction was voluntary, but I am hopeful!

Saturday morning, a five-year-old boy was brought to the hospital with poliomyelitis. Five minutes after the physical therapy section was notified, our corpsman was getting salvage woolen blankets and oiled silk for hot packs from the medical supply, while I went to find out where I could get hot water. I found it, and also a washing machine with an electric wringer. The plug was off the cord, but small matter—our corpsman go one somewhere and fixed it. (Which reminds me, I forgot to ask him how he got it, for plugs are a scarce item in the Philippines.) Both lower extremities appeared to be involved, and there was moderate spasm in the hamstrings, foot extensors, and toe flexors. By the time the hot packs for thighs, legs, and feet were cut, the water and wringer were ready. At the time, I remember thinking, "The biggest part of the work is done!"—but I was wrong, for it took "How the Elephant Got His Trunk" and all the "Winnie the Pooh" stories I could remember to get the packs on. At present (three days later), the pain has subsided, but minimal spasm is still present.

The majority of our patients are either orthopedic or dermatitis cases. Someone is continually turning over a jeep or playing too roughly at football. Skin diseases in the Philippines are rather prevalent. Prickly heat—we call it by its lay name because it is so common—is the most predominate. We have found by trial and error method that this condition improves most readily when ultraviolet is administered in suberythemal doses. Using an ultraviolet lamp with an M.E.D. of 30 seconds at 30 inches, we have had good results in starting the treatment with 15 seconds and increasing the dosage 5 seconds each day for ten days.

Don't think we work all the time. We have time for playing and sightseeing, too. Last Sunday a group of twenty of us went to Pagsanjan Falls. The roads in the Philippines are still rather rough and dusty, but we had the pleasure of staff cars and enjoyed every minute of that trip. On the way to Pagsanjan, the newcomers to the Philippines discovered that bananas grow upside down on trees and that some bananas are green when they are ripe. We stopped several times to take pictures of children riding carabaos and to watch the Filipino's unique method of harvesting rice, which is almost a ritual.

After dinner at the lodge we changed into swimming suits and started up the Pagsanjan Falls in bancas. A banca, a long narrow boat, which resembles a canoe, is actually a hollowed trunk of a large tree. The boatmen in the bow and stern propel the banca with paddles. For safety reasons, each banca carried just two passengers. We were off, our convoy of bancas, up the Falls —7 kilometers. As we turned the bend in the river, we saw huge cliffs on either side of a tiny vein-like stream. The nearer we got to the gorge, the cooler it became. The sun which no longer beat down on us became streaked and patchy, and suddenly was gone. The peace and calm of the mouth of the gorge was broken only by the distant chatter of monkeys and songs of birds. But alas, just as I settled down to enjoy the tranquility of nature, the spell was broken. The boatmen jumped from the banca and pushed and tugged the boat to keep it from being swept backward—we had climbed the first rapids. I had missed that one completely, being too engrossed with inner peace, but the thrill of the following eight was well worth getting completely soaked. It took about two hours to climb the series of rapids. When we arrived at the top, we swam in the cool, crystal-clear lake underneath a 300 foot waterfall—the clearest water in the Philippines.

Shooting the rapids on the way down was the biggest thrill of all. The pace was breathtaking in itself, but, finding us, banca and all, flying towards boulders that surely were not far enough apart for the banca to go through, led to an attempt at self-preservation. Before the act could be accomplished, the banca had flown between the boulders and we had only a recollection of having drawn our elbows toward our bodies and a feeling that the banca itself had drawn in its sides. It took less than thirty minutes to get back to Pagsanjan Lodge from the top of the Falls. We were exhausted, and by the time we arrived home Sunday night, we had to force whatever energy it takes to roll down mosquito nets and say "goodnight."

Coming Meetings

Date	*Organization*	*Place*
July 6-12	American Physiotherapy Association	Asilomar, Pacific Grove, Calif.
Sept. 2-6	American Congress of Physical Medicine	Hotel Radisson, Minneapolis, Minn.
Oct. 31 to Nov. 7	American Occupational Therapy Association	Hotel Del Coronado, Calif.

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A Poliomyelitis Program in a General Hospital. Josephine J. Buchanan, Susanne Hirt and Florence Wrisley. Arch. Phys. Med., May 1947.

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Postural Treatment of the Paralyzed Deltoid Muscle. Bernard Kleiger. Bull. Hospital for Joint Diseases, Oct. 1946.

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Foot Strain: Etiology and Treatment. Frances Baker. Arch. Phys. Med., April 1, 1947.

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ABSTRACTS

John S. Coulter, M.D.

Bed Exercises

Nila K. Covalt, M.D. IN ARCHIVES OF PHYSICAL MEDICINE, Vol. XXVIII, No. 1, January 1947.

It has long been an accepted premise in the practice of medicine that a patient must be put at rest in order to give the healing forces of nature an opportunity to make him well again. It has been only in the past few years that this hypothesis has been examined. This examination was made necessary because of the shortage of man power during the war. The results have been not only instructive but, in many instances, astounding. The old premise of bed rest per se has been disproved time after time.

The average patient in a hospital suffers 10 per cent of the time from pain and 90 per cent from boredom. This was particularly true in military hospitals at the start of the war. During that time, when every man was badly needed, there were approximately fifty thousand men sitting around in military hospitals just waiting for time and nature to complete their convalescence. Definitive medical and surgical care had been accomplished. They were bored with sitting around with nothing to do until they were able to go back on the job.

At this time, the Convalescent Training Program was started by the Army Air Forces. The objective of this program was to return the men to duty as soon as possible through (*a*) a program of physical exercise and (*b*) an educational program designed to keep them mentally alert while at the same time they could be taught certain things that might be of value to them later, either in their military or in their civilian life.

The results of such a program have been exçeptional. Many men were able to leave the hospital at a much earlier date than was ever believed possible before. Some of these men returned to duty in better physical condition than they had been in before they became ill.

Results

My own observations are as follows:

1. Patients required little or no morphine after the first forty-eight hours. Some would request it occasionally after that at night, but even then its use was definitely decreased, as were the amounts of all other sedatives the patients always used to request. These patients never request sedatives after they leave the hospital either, a fairly common procedure with other patients.

2. There were far fewer complaints of "gas pains," sometimes none, and rarely any complaints of abdominal pain after the second day.

3. There was little or no nausea after the first two days. By the second day the patients usually requested food, and their appetites improved rapidly.

4. There was less need for catheterization, and none when the patients got up.

5. Postoperative cystitis occurred with less frequency. I should like to suggest that this is probably due to the bladder being distended less often when less catheterization is needed and, at the same time, to the earlier bathroom privileges and avoidance of a bed pan. Since 90 per cent of the women patients with cystitis have had cultures positive for bacillus coli and since almost 100 per cent of them used to have cystitis before early exercise and ambulation were introduced, I think that this may be enlightening.

6. When the patients first sat up on the edge of the bed (by the second day usually), they rarely complained of dizziness. When they sat up in a chair, they tired less quickly and usually asked to sit up much longer than usual. The first time the patients sat up, the usual time of fifteen to twenty minutes was increased to thirty to forty-five minutes at the patients' request, because they experienced no fatigue. After that, they requested to be allowed to sit up at more frequent intervals and for longer and longer periods of time.

7. Backaches were rarely mentioned by the patients.

8. Fewer enemas were required. Normal bowel movements were usually established within the week, if not by the fourth or fifth day.

9. When the patients took their first steps, there was no tingling in the feet; the knees did not buckle; the patients walked in a fairly erect position and required no support to walk across the room (although it is certainly unwise to take chances and not have an attendant the first time or so.) Often with the first steps, they would stop, look around in surprise and say, "Why, my legs feel fine. I believe I could walk right out of here."

10. In addition to the marked lessening of the occurrence of cystitis, not one of these patients so exercised had other complications. No emboli occurred in this series. The complication mentioned before was the only one observed, and it cannot be entirely blamed, if blamed at all, on these exercises, even though they cannot be excluded. One medical patient was admitted to the hospital with a pulmonary infarct and carried on this regimen with good results. Two others had infarcts from chest conditions which were not surgical and received the same treatment.

11. The patient was usually ready to go home within five to eight days. He could always go by car unless it was a question of having to climb a flight of stairs on his arrival home. He was permitted to walk up and down stairs just as quickly as he himself felt strong enough, however.

12. Irrespective of the type of abdominal surgery, the patients were usually ready to go to work within a month. Several were ready for work within that time—only to be delayed by preexisting factory insurance rules, which set a certain number of weeks before each type of postoperative patient may be allowed to return to work, irrespective of how he feels.

One woman, aged 46, a teacher and school principal, with a complete hysterectomy and a perineal repair, returned to full time work in one month and two days. A second woman, age 56, who had had a coronary condition six months previously, and electrocardiographic proof of it before a cholecystectomy was done, returned to manage her dress shop in one month and went on a buying trip to New York in six weeks from the time of her operation.

Rehabilitation of the Tuberculous: The Program of a Municipal Sanatorium

I. D. Bobrowitz, Medical Superintendent, Municipal Sanatorium, Otisville, New York. In AMERICAN REVIEW OF TUBERCULOSIS, 55:1:43, January 1947.

A detailed description of the Otisville rehabilitation program is soon to be published by the National Tuberculosis Association. Some of the main features of our work and some of our experiences are presented below.

A complete rehabilitation process involves not alone the period in the sanatorium, but also the time before admission and after discharge. Our program, therefore, can be divided into three intimately related phases which are of equal importance—the presanatorium, insanatorium and postsanatorium periods.

From the time of diagnosis and thereafter, public and voluntary agencies, such as medical, welfare, social service and public health nursing, work with the patient and family and refer the patients to the sanatorium. These are known as the referring or active working agencies. Rehabilitation groups come into the picture during and after the sanatorium period. The functions, responsibilities and relationships ascribed to these organizations had been agreed upon after a series of meetings attended by the sanatorium and the agencies.

Conclusion

Successful rehabilitation requires a comprehensive and effective sanatorium program and close cooperation between the sanatorium and the community. All of the community services must be integrated to serve the patient and family during all the phases of treatment, from the time of diagnosis until the individual is fully adjusted. Under these conditions patients will accept sanatorium care, remain till their tuberculosis is arrested and follow through with necessary rehabilitation plans.

The rehabilitation program we have outlined attempts, in a practical and efficient manner, "to restore the tuberculous to the fullest physical, mental, social, economic and vocational usefulness of which they are capable."

Fibromyositis, Including Its Industrial Implications and Special Reference to Referred Pain

F. W. Slobe. In OCCUPATIONAL MEDICINE, 2:329, October 1946.

Slobe asserts that ailments classed under the broad grouping of "fibromyositis" are among the commonest diseases of adults. They are neither confined nor peculiar to industry. Their industrial significance arises from the frequency of involvement among the age groups employed in industry, the frequency of actual or alleged association with strains, sprains, contusions, continued exertion and minor repetitive motions, the vast number of lost workdays and the huge amount of impaired efficiency caused by these ailments. The author defines fibromyositis as a localized (occasionally diffuse) area of infiltration. The causation is not known. Referred pain and tenderness are frequent manifestations and are likely to cause errors in diagnosis. Characteristics of referred pain from the four most frequent sites of origin are described, namely the dorsolumbar region, the lower part of the back, the shoulder girdle and upper dorsal region and the crevical region.

Curare in Clinical Practice

News and Comment. In BULLETIN OF THE U. S. ARMY MEDICAL DEPT., 7:2:175, February 1947.

Tubocurarine, which is an alkaloid of curare and has the characteristic physiologic action of curare, belongs to a group of compounds known as quaternary ammonium salts. In general, these salts exhibit the property of paralyzing neuromuscular conduction at the myoneural junction. The majority of these salts, however, have other properties which overshadow and obscure this action. Almost alone among them, tubocurarine, in certain concentrations, has a purely myoneural-junction effect. This myoneural-junction action is most probably related to the configuration of the molecule rather than merely to the chemical composition. Acetylcholine and prostigmine have a similar molecular configuration, and under certain circumstances can be made to exert a curariform effect, and conversely, curare can be made to cause a muscle twitch. The physical chemists have shown that molecules of this stereochemic type exert specific effects on vital membrane structure .

Patients almost invariably note a pleasurable feeling of relaxation within two hours after injection. Under favorable conditions, in fact, most of them doze during this period. There is an associated fall in systolic pressure, averaging 20 points, which is related to muscle relaxation and not a specific vascular effect. No side effects of clinical significance have been noted within the dosage range employed. Once concentrations pass a critical level, however, central effects supervene with mental confusion and a feeling of marked tenseness in addition to the classical toxic signs. There have been no toxic effects on any organic system over periods of time, and no changes in body economy or general well-being. No tendency to habituation has appeared in this series, although one patient has had more than seventy-five injections. The existence of any myasthenic tendency or kidney disease are contraindications. Since curare is eliminated largely unchanged in the urine, poor renal function conceivably could elevate blood concentrations to a dangerous degree.

Integrative Pattern of Excitation and Inhibition in Two-Neuron Reflex Ares

David P. C. Lloyd, Laboratories of The Rockefeller Institute for Medical Research, New York. In JOURNAL OF NEUROPHYSIOLOGY, 9:6:439, November 1946.

Summary

An afferent volley arising in the nerve of a given muscle or muscle fraction has, by direct impingement upon motor nuclei, the following actions:

1. If above threshold, it discharges motoneurons that supply that muscle or muscle fraction; otherwise, excitation is subliminal.
2. It facilitates the action of motoneurons that supply the muscle remainder, or synergists, at the same joint.
3. It inhibits the action of motoneurons that supply antagonists at the same joint.

The afferent volley in question, by direct action, neither excites nor inhibits motoneurons of muscles, flexor or extensor, that act at neighboring joints.

In every instance the actions described are in strict accord with the requirements of reciprocal innervation.

The origin and distribution of excitation and inhibition so evoked indicate the role they play in myotatic reflex performance.

The mutually dependent muscles of a joint, together with the direct reflex paths that bind them, may be considered as constituting a myotatic unit.

The myotatic units in the first instance are independent one from another. Two-joint muscles form peripheral bridges between adjacent myotatic units.

Without the necessity for other than direct reflex connections, the myotatic unit exhibits, complete within itself, the elementary mechanism of reciprocal innervation.

Medical Rehabilitation: The Doctor's Responsibility

Alfred R. Shands, Jr., M.D., Wilmington, Delaware. In DELAWARE STATE MEDICAL JOURNAL, 19:1:1, January 1947.

In the 18th century, Cullen once wrote, "For when many new facts have been acquired, it becomes requisite that these should be incorporated into a system whereby not only particular subjects may be included, but the whole may be rendered more complete, consistent and useful." This is the status of rehabilitation today. The war has been the means of acquiring an enormous volume of new facts on all types of subjects relating to the rehabilitation of the sick and wounded. Now it becomes requisite that this accumulation of new factual data be integrated into a system which will be "complete, consistent and useful" in the work of attaining the goal of rehabilitation, namely, "the restoration of the handicapped to the fullest physical, mental, social, vocational and economic usefulness of which they are capable."

From the story of Sgt. Smith, the statistics of the A.A.F. virus pneumonia and rheumatic fever patients, the deconditioning experiments of Ancel Keys, the proven increased work load on the heart in the lying position and the statistics of early mobilization after surgery, there is a lesson to be learned which we as physicians must not overlook. It is our responsibility to restore the sick and wounded to maximum usefulness in the minimum time. How better can this be done than by adding to our present systems of therapy a system of active medical rehabilitation so recently learned during World War II. This must be done, for it shall not be said that we as physicians are neglecting our duty in failing to apply to medical practice the concepts of the "third phase of medicine."

Active Immunity to Poliomyelitis in Chimpanzees Following Subclinical Infection

Joseph L. Melnick, Ph.D., and Dorthy M. Horstmann, M.D. Section of Preventive Medicine, Yale University School of Medicine, New Haven. In JOURNAL OF EXPERIMENTAL MEDICINE, 85:3:287, March 1, 1947.

In poliomyelitis research immunity to reinfection has generally been measured by testing the resistance of monkeys to a challenge dose of homologous or heterologous virus inoculated into the brain, or occasionally instilled into the nose whence virus gains access to the brain via the olfactory bulbs and tracts. That these portals of entry are not those used by the virus in the natural disease is obvious in the case of the former route and is unlikely in the latter instance. Yet no other portals could be satisfactorily used to introduce the challenge inoculum because rhesus monkeys, which have been the chief experimental animals, succumb only irregularly when given virus in the skin or peritoneal cavity and not at all when virus is ingested by mouth. To study immunity to poliomyelitis virus introduced by more natural routes we have turned to the chimpanzee as an experimental animal, for Howe and Bodian have demonstrated that these animals can be readily infected by feeding virus. In the majority of instances, no clinical signs of infection appear, although the animals become transient intestinal carriers of the virus. Not only has this finding been confirmed, but it has been shown also that carrier states may be set up in chimpanzees when virus has been inoculated in the skin.

The present report is concerned with the development of immunity to reinfection with poliomyelitis virus in chimpanzees. The measure of infection in these experiments hinges on the question as to whether the animal does or does not become an intestinal carrier of poliomyelitis virus following its ingestion or inoculation in the skin, and the measure of immunity is based on whether the carrier state can be again produced by a challenge dose of homologous virus.

Summary

This report is concerned with the production of subclinical poliomyelitis in the chimpanzee, and immunity to such infection. Subclinical infection was produced in eight chimpanzees by the administration of virus orally or intracutaneously, and was measured by the production of a virus carrier state and the development of neutralizing antibodies. Immunity was tested by attempting to induce the carrier state again by a challenge dose of virus by the same routes.

With an homologous strain as the challenge virus, immunity as defined here was produced in each of four chimpanzees tested. Neutralizing antibodies to the homologous strain were present about one month following the first exposure to virus by either the oral or cutaneous route.

In another group of two chimpanzees, one developed neutralizing antibodies and immunity to heterologous strains, and one did not.

Bismuth Therapy and Physiotherapy in Rheumatoid Arthritis

J. Shulman, M.D., Ch.B., D.Phys.Med. Honorary Physician in Charge of Physical Medicine Department, Coventry and Warwickshire Hospital, Coventry. In BRITISH JOURNAL OF PHYSICAL MEDICINE, 10:1:8, January-February 1947.

The organization of a physical medicine department in a provincial general hospital demands, amongst other things, the management of an apparently endless stream of sufferers from all the rheumatic diseases, ranging from Still's disease in the young, through rheumatoid arthritis and spondylitis ankylopoetica in the young adult, to gout, fibrositis and menopausal arthritis in middle life, and finally to all stages of degenerative osteoarthritis in the elderly. It is not implied that these age groups are consistent in their rheumatic diseases relationship, but they do, perhaps, give at least a rough basis of the major frequencies within the groups.

Merely to depend upon physical medicine methods alone in the treatment of these cases is to invite many failures and disappointments and, what is more serious, to waste the time of both patients and physical therapy staff.

Bismuth therapy and gold therapy in rheumatoid arthritis

Until the advent of gold therapy in rheumatoid arthritis there was little else in the way of active therapy except endless treatments by heat radiations, actinotherapy, ionization, diathermy, massage, movements and other physical adjuncts, together with orthopedic supports to prevent and correct deformity.

So eagerly has gold been accepted as the specific for rheumatoid arthritis that, despite its high percentage of toxity, little else has been found to replace it, in spite of the rival claim of bismuth. Douthwaite in 1944 made a cautious investigation into the possibilities of bismuth in the treatment of rheumatoid arthritis, particularly because it has the advantage of being less toxic than gold; but my own impression, after visiting various centers for the treatment of rheumatic diseases, is that bismuth has not been used extensively in these cases.

In cases of rheumatoid arthritis in which the general condition is reasonably good and the blood count is reasonably normal, it has been found that better results are obtained by combining the administration of bismuth with ionization to the affected joints. A one per cent solution of "T.C.P." (trichlorophenylmethyliodosalicyl) is ionized into the tissues of the affected region for 60-100 milliampere-hours—thus introducing ions of chlorine, iodine and salicylate into the area.

Treatment of Contractures with Novocaine Block

N. A. Krysheva and S. M. Panyutina. In AMERICAN REVIEW OF SOVIET MEDICINE, 4:3:198, February 1947.

Contractures following war injuries are of great interest to neuropathologists, physiologists, and orthopedists. The number of cases is large, the duration is protracted, and many are incurable. There has been no adequate classification based on etiology with a consequent difficulty in applying appropriate treatment. Astvatsaturov distinguishes the following contractures: (1) mechanical, (2) trophic, in which the traumatized muscle atrophies and, (3) reflex of sympathetic or psychogenic origin. Besides these Astvatsaturov distinguishes (4) antagonistic and (5) analgic contractures and supplies descriptions of both.

The treatment of contractures by Orbeli and his group deserves special emphasis, particularly the work submitted by Ginetsinski. It is possible to study contractures according to the physiologic mechanism involved. As a result of degeneration following nerve damage, muscles react to acetylcholine and potassium and tonic contractures appear characteristic of embryonic muscle tissue. Interference with higher inhibitory centers intensifies the tonic reflex apparatus; this may be reinforced by proprioceptive stimuli. There are also special influences which stimulate systrophic processes in the muscular and tendinous tissues, e.g. connective and fatty degeneration. Orbeli called contractures "defensive reflexes." Clinical observations show that experimental methods used to induce and strengthen defensive reflexes in brain and cord injuries also intensify the contracture. It is possible to show a similar effect in the Leri sign, contrary to what might be expected and to what is the case in algesic forms of contracture. Aggravation of the contracture was observed when the points of attachment of the muscle were made to converge and not when they were separated, as happens when one observes the Leri sign and Marie-Foix reflex. By nature, this reaction, i.e. the reaction in the reflex contractures of which Ginetsinski speaks, is of a myostatic type.

Conclusions

1. Reflex contractures occur immediately after trauma or immediately following surgical manipulation. They are demonstrated when methods stimulating Marie-Foix, Leri and Mayer defensive reflexes are applied.

2. Reflex and dystrophic phases of contracture are improved by novocaine block.

The Effects of Water Diuresis and Exercise on the Volume and Composition of the Urine

J. A. Barclay, W. T. Cooke, R. A. Kenney and M. E. Nutt, Departments of Physiology and Medicine, Birmingham University, England. In AMERICAN JOURNAL OF PHYSIOLOGY, 148:2:327, February 1, 1947.

During a class experiment made in October 1943, it was found that results obtained differed from those reported by Eggleton. We therefore decided to reinvestigate the effects of water intake on urinary volume, pH and chloride excretion, and in addition, to make further investigations of the effects of exercise on urinary secretion. The experiments may be conveniently divided into groups: (1) The effects of increased water intake on urinary volume, pH and chloride excretion, and the influence of meals and time of day on these results. (2) The effects of exercise on the course of a water diuresis and the influence of time of day, etc., on the changes produced. (3) Renal dynamics during diuresis and exercise, (a) glomerular filtration rate, (b) renal blood flow.

Summary

1. Results are presented of experiments carried out over three years on the changes occurring during diuresis and the effects of exercise, time of day, and meals on these changes.

2. As a result of exercise, water diuresis may or may not be inhibited.

3. pH of the urine during diuresis tends toward 6.9 irrespective of initial level; during exercise there was always a marked fall.

4. It has been found that there is always a fall in plasma flow, in filtration rate and a rise in filtration fraction during exercise.

5. As a consequence of taking water, there is either a rise or fall in chloride excretion. It is shown that this is a reflection of the varying degrees of tubular activity towards chloride, and as a result of exercise, tubular activity increases still further and there is a marked fall of chloride excretion.

6. Our findings offer support for the postulate that there is a proximal and distal component to reabsorption.

Low Back Pain: A Different Cause and Treatment —The Pronation Syndrome

Laurence Jones, M.D., Orthopedic Service, Cedars of Lebanon Hospital, Beverly Hills, Calif. In INDUSTRIAL MEDICINE, 16:2:57, February 1947.

There is a great diversity of opinion as regards almost every aspect concerned with acute and chronic low back pain. In spite of this variance, the subject of this paper advances a different approach.

A considerable mass of clinical material, most of it representing experiences of the past four years, will be presented to indicate that a variety of other symptoms in addition to those of low back pain can be caused by an exceedingly common type of faulty foot posture; namely, pronation or internal rotation of the feet.

Since all of these symptoms may have one cause, this complex has been termed the "pronation syndrome." Evidence of various kinds will be presented to indicate that this primary pronation or internal rotation of the feet produces secondary anatomical postural changes in the structures above, which, in turn produce multiple deviations in various weight-bearing lines. Some of these are demonstrable clinically by observation. Others, such as changes in the pelvic and spinal alinement can not only be demonstrated in serial radiographs, but the differences are also sufficient to be capable of actual measurement. From the diagnostic standpoint the presence of the syndrome should be suspected when confronted by one or all of four cardinal symptoms. These are: generalized fatigue, dull leg aches of various distributions, low back pain of various patterns, and sciatic neuritis or sciatica.

Physical Rehabilitation of the Severely Handicapped

Earl C. Elkins, M.D., Rochester, Minnesota. In JOURNAL OF THE KANSAS MEDICAL SOCIETY, 48:2:57, February 1947.

There are many types of conditions related to the central nervous system which may cause severe disability. Of course many patients who have such disability cannot be helped by physical rehabilitation. In this presentation only those types of disabilities that are reasonably common will be considered. Some of these conditions have increased in frequency owing to the war, industrialization and the increase in the number of automobile accidents throughout the nation. Conditions which most commonly produce severe disability, which in the past frequently were not considered amenable to physical rehabilitation are neurologic lesions resulting in paraplegia. These disabilities may result from injury to the spinal cord, benign neoplasms, infection, vascular accidents and degenerative diseases which are not progressive. Many of these patients, in the past, were considered to be permanent and complete invalids. Therefore, no particular treatment was attempted and the patient became totally dependent on his family or on society.

Summary

Training and rehabilitation of severely disabled patients require some special skills. It cannot be relegated to untrained persons. However, common sense, patience, ingenuity and the ability of the physician to put himself mentally in the position of the patient will have much to do with whether the physician continues to have a defeatist attitude with regard to rehabilitation or whether he attempts to help the patient to gain even a small degree of independence.

It should be emphasized that elaborate equipment is not necessary. If the patients who receive training are carefully selected, long periods of hospitalization may not be necessary. With a basic knowledge of muscular function on the part of the physician and with the help of a trained technician, many procedures can be evolved without the necessity of special training in reeducation of muscles and in general exercise.

It also should be pointed out that patients or their families cannot be taught in a few easy lessons how to carry on rehabilitation unless the patients have been partially trained before treatment is attempted at their homes.

Not all patients who are severely disabled are going to be successfully rehabilitated or even partially so. In some cases, complete failure will result; however, if the activity of only a relatively small percentage of these patients is returned to somewhere near normal, the effect will be worthwhile. Many of the patients need not lead the life of a complete invalid and many can be made less dependent on their families and on society than they would be without training.

The Effect of Limb Position in Seated Subjects on Their Ability to Utilize the Maximum Contractile Force of the Limb Muscles

P. Hugh-Jones, M.R.C. Physiology Laboratory, G.W., A.F.V.S., Lulworth. In JOURNAL OF PHYSIOLOGY, 105: 4:332, January 15, 1947.

It is well known that human muscles in maximum contraction exert a large force in the line of the tendon, often exceeding 1000 lb., and that this force is dependent on the initial length of the muscle as shown by Evans & Hill (1914), Reijs (1921), and others. In everyday life these forces are not noticed, for the muscles work at a mechanical disadvantage, usually of about 10:1, which gives a high gear-ratio and allows rapid movement. The precise mechanical disadvantage is dependent on the angle of the acting joint and this finally determines the force which can be exerted.

Summary

1. An account is given of experiments designed to determine how the maximum pull or push exertable on an isometric hand control, and the maximum push exertable on an isometric foot-pedal, vary with different control positions relative to a seat. It is shown that, in general, push or pull increases with extension of the acting joint until a maximum is reached just before the joint becomes straight.

2. For pushing on a control, against a seat back-rest, the findings agree with the theory that the limb acts as a mechanical 'toggle' between the control and the back-rest. This toggle-action markedly increases the exertable push, and the relationship between control and seat becomes highly critical; it was found that the action is stopped at a well-defined 'limiting angle' and that the effect was more pronounced in the lower limb. The 'limiting angles' found were 160 degrees for knee-extension and, approximately, 135 degrees for elbow-extension.

3. For an isometric foot-pedal placed in front of a seat, maximum push is attainable when the subject's thigh is about 15 degrees to the horizontal and his knee is extended just to reach the limiting angle. In this position mean maximum efforts for three different, selected, groups of subjects were 845 $\pm$ 35 lb. (6), 691 $\pm$ 66 lb. (32), and 689 $\pm$ 62 lb. (16).

4. For an isometric hand-lever, maximum pull or push is attainable when the elbow is extended up to the limiting angle, the hand-grip is about at elbow height for the seated subject, and the lever moves in a vertical plane which passes through the shoulder-joint.

5. To exert pressure between an isometric hand-grip and a seat back-rest is subjectively very unpleasant, though the exertable push, owing to toggle-action, is greater than the pull under comparable conditions. For reasons given, it is concluded that the conventional 'pull-on' hand-brakes for vehicles are preferable to a 'push-on' variety.

The Significance of Lesions in Peripheral Ganglia in Chimpanzee and in Human Poliomyelitis

David Bodian, M.D. and Howard A. Howe, M.D. Poliomyelitis Research Center, Department of Epidemiology, Johns Hopkins University, Baltimore. In JOURNAL OF EXPERIMENTAL MEDICINE, 85:3:231, March 1, 1947.

Recent reports have dealt in some detail with the lesions found in peripheral ganglia in fatal human poliomyelitis cases, and in monkeys inoculated by routes simulating some possible portals of human infection. Because the peripheral sensory ganglia are clusters of nerve cell bodies which serve as way-stations from the exterior body surfaces (including the mucous surfaces) to the central nervous system, evidence based on such findings has led to postulates by these workers and earlier by us regarding the possible routes of transmission of the virus from mucus surfaces of the alimentary tract to the central nervous system.

Summary and Conclusions

1. The peripheral ganglia of eighteen inoculated chimpanzees and thirteen uninoculated controls, and of

eighteen fatal human poliomyelitis cases, were studied for histopathological evidence of the route of transmission of virus from the alimentary tract to the central nervous system.

2. Lesions thought to be characteristic of poliomyelitis in inoculated chimpanzees could not be sharply differentiated from lesions of unknown origin in uninoculated control animals. Moreover, although the inoculated animals as a group, in comparison with the control animals, had a greater number of infiltrative lesions in sympathetic as well as in sensory ganglia, it was not possible to make satisfactory correlations between the distribution of these lesions and the routes of inoculation.

3. In sharp contrast with chimpanzees, the celiac and stellate ganglia of the human poliomyelitis cases were free of any but insignificant infiltrative lesions. Lesions in human trigeminal and spinal sensory ganglia included neuronal damage as well as focal and perivascular infiltrative lesions, as is well known. In most ganglia, as in monkey and chimpanzee sensory ganglia, these were correlated in intensity with the degree of severity of lesions in the region of the central nervous system receiving their axons. This suggested that lesions in sensory ganglia probably resulted from spread of virus centrifugally from the central nervous system, in accord with considerable experimental evidence.

4. Two principal difficulties in the interpretation of histopathological findings in peripheral ganglia were revealed by this study. The first is that the specificity of lesions in sympathetic ganglia has not been established beyond doubt as being due to poliomyelitis. The second is that the presence of characteristic lesions in sensory ganglia does not, and cannot, reveal whether the virus reached the ganglia from the periphery or from the central nervous system, except in very early preparalytic stages or in exceptional cases of early arrest of virus spread and of lesion production.

Peroneal Palsy Caused by Crossing the Legs

Major Simon H. Nagler and Major Leo Rangell (MC) AUS. In JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION, 133:11:755, March 15, 1947.

Of the peripheral nerves closest to the surface, least protected and most vulnerable to both acute and chronic trauma, the common peroneal nerve ranks high. Thus, Wilson places it second only to the musculospiral and ulnar nerves for frequency of damage, while it stands first in Cassirer's series of over 1,000 cases.

Sitting with the legs crossed, a ubiquitous habit in modern man, is strikingly brought out as a common factor in producing the symptoms referable to the peroneal nerve in our observed cases. This habit, particularly prevalent in men, has been described a few times before as a factor in the production of peroneal palsy, but has for the most part been overlooked and neglected as a causal agent in this condition.

A few final words in regard to therapy are in order. By prompt recognition and removal of the causal factors in a case of peroneal palsy due to crossing the legs, one can prevent serious neural damage. Some of our patients even while discussing their condition continued to assume the causative traumatic position. For these patients the deleterious effect of this seemingly innocent habit must be repeatedly stressed. Mechanical support of the foot, radiant heat, galvanism, and adequate nutrition with large doses of thiamine chloride were utilized. The therapeutic results were good.

Eight cases are reported of unilateral peroneal palsy occurring in healthy military personnel.

A common causal factor present in all 8 cases was the chronic habit of sitting with the legs crossed, which is shown to result, in persons of asthenic habitus, in a compression neuritis of the common peroneal nerve of the uppermost leg. This may either result in symptoms or may merely sensitize the nerve to other causal agents.

Another important causal factor in the reported cases was the assumption of various occupational positions incident to military duties and traumatic to the common peroneal nerve.

Lesions in Muscle in Arthritis

H. J. Gibson, G. D. Kersley and M. H. L. Desmarais. In ANNALS OF RHEUMATIC DISEASES, 5:131, June 1946. Abstracted in JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION, 133:1:67, January 4, 1947.

Perivascular cellular reactions in the muscles themselves and paravascular lesions in the fibrous and fatty supporting connective tissue were observed by Gibson and his associates in specimens of biopsy material taken from 11 patients, with typical rheumatoid arthritis in 10 and with some atypical features in 1. There were 5 men between the ages of 48 and 63 and 6 women between the ages of 33 and 52. Similar changes were found in active and quiescent cases, whether or not they had been treated with gold salts. All affected tissues were of mesodermal origin. It is suggested that the noxious agent is a blood borne irritant.

Complete Forward Dislocation of the Elbow-Joint

R. Salisbury Woods, F.R.C.S. Late Major R.A.M.C.; Surgical Specialist, Station Hospital, Diego Suarez. In THE CLINICAL JOURNAL, 75:6:216, November-December 1946.

Of the various types of dislocation at the elbow-joint that of the whole forearm backwards is the most common, while those of displacement to either side are far less frequently encountered. Forward dislocation is very rarely met at all, and so the following case is recorded:

At first reduction was attempted by Bohler's method of traction on the extended elbow. But after three successive attempts, exerting all my weight and strength against the countertraction of two African nursing orderlies for five minutes at each effort, I decided this would not avail, however long continued. It remained, therefore, to make further trial with the elbow flexed, an assistant gripping the hand and maintaining powerful traction, as for the reduction of a Colles's fracture, while I endeavored to manipulate the forward displacement of ulna and radius downwards and backwards. Even this was very difficult, but after two minutes' extremely hard work the dislocated bones suddenly slipped into position, the articular surface (coronoid fossa) of the ulna "snapping home" with a palpable click.

The accompanying trauma of the soft tissues resulted in the usual severe extravasation, with about two inches of edematous swelling of the arm, elbow region, and forearm. This was treated by light stroking massage, gentle active movements from the next day, and support in a sling. Easy natural function was encouraged by allowing the patient to use the injured limb for dressing and feeding himself.

This departure from the orthodox static methods of wearing a P.O.P. cast for a fortnight, or of three weeks in a sling, was emboldened by a belief that the dreaded myositis ossificans really results from the repeated traumata of passive (forced) movements and of deep powerful massage, whereas light natural function (with support where necessary) is the quickest road to recovery after all injuries.

Edema or Herniations of Fat Lobules as a Cause of Lumbar and Gluteal "Fibrositis"

W. S. C. Copeman, M.D., F.R.C.P. and W. L. Ackerman, M.D., M.R.C.P., London, England. In ARCHIVES OF INTERNAL MEDICINE, 79:1:22, January 1947.

Fibrositis as a clinical entity has long been accepted in England, where it constitutes about 12 per cent of all medical cases seen. It has always been recognized, however, that its pathologic foundations are slender, resting as they do almost entirely on the theories of Gowers and the observations, comparatively few in number, of Stockman at the beginning of this century.

Nature of the Pain

As the result of the work of Sir Thomas Lewis and his school it has been accepted that the pain of fibrositis generally has its origin in certain focal points from which the subjective pain complained of by the patient is referred according to a segmental scheme. Such referred pain may be felt at a considerable distance from its real source, as is seen in cases of sciatica whose origin may be found in focal points situated in the lumbar or gluteal regions. These points are variously referred to as "trigger points", "myalgic spots", or "fibrositic nodules" when they are palpable. They are definite entities, since it is found that the patient winces involuntarily each time that the palpating finger exerts pressure there, while pressure of the same intensity exerted only a few millimeters distant will not produce the same response; a certain degree of more generalized deep tenderness may however be present and must not be confused. Pain in other areas which is being referred from a trigger point will generally be reproduced by the pressure, in addition to the local tenderness.

Therapy

The operative procedures in these cases were undertaken chiefly for the purposes of investigation. Although these surgical procedures did cure the patients, we do not advocate them in most cases because we believe that relief can be afforded by other, less drastic measures. We believe that the pathologic conditions described can be shown to have some direct association with several methods of treatment which at present rest on an empiric basis.

Heat, Massage and Movement—The pathologic basis offered in this paper for the cases of fibrositis described would appear to place these traditional methods of rheumatic treatment ("the therapeutic tripod") on a scientific footing for the first time. It is reasonable to aim at increasing, by means of heat, the local blood supply and so the drainage from an area which is the seat of gradually increasing congestion, edema and tension.

In the early stages of herniation of the fat lobules, it is equally reasonable to endeavor to "reduce" them by massage, to force the accumulated edema fluid into the lymph drainage channels, and later when they are no longer reducible, owing to adhesions to neighboring lobules, to break them up by mechanical pressure. It seems evident that it is in this way that the disappearance of "fibrous nodules" as the result of massage can be explained.

The rationale of active muscular movement is that it is the essential factor for the efficient functioning of the lymphatic system, and in early cases in which the lesion is still reversible active muscular movement is found to be helpful. It is the common experience that the condition is worse while the patient is lying in bed or after a night's rest.

Summary and Conclusions

A systematic study of fibrositis of the lumbar and gluteal regions has been made in a body of picked men. The pain has been studied clinically, and we have confirmed the occurrence of localized "trigger points" from which pain in this condition may be widely referred. The exact situation in which these occurred in a series of patients was charted, and a "pain pattern" of definite shape resulted.

Our previous observation that these points may arise during any pyrexial illness, or as the result of trauma, was confirmed; also that the subjective pain often disappears, but that the point remains and can be detected by its tenderness on palpation. It can be reactivated subsequently, and may gradually become the seat of chronic pain.

The back was carefully dissected in fourteen bodies with particular reference to the sites at which pain had chiefly been found to occur. It was found that a "basic fat pattern" was constantly present, even in the most cachectic subjects, in whom all other fat was absent. This "fat pattern" was observed to correspond with the "pain pattern" already charted, in situation and shape.

Our observations show that the production of pain at these trigger points takes place in certain fibrofatty tissue, and not in the muscles, as has often been stated. The local lesion demonstrated in those cases in which biopsy was performed consisted of an increase in the volume of certain fat lobules in situations where expansion was normally limited by an unyielding fibrous capsule. In one case this increased tension in the lobule appeared to be the result of an old hematoma.

In the clinical cases described in this paper this process had progressed further, and actual herniation of these lobules had occurred through weak spots in the fibrous compartment or capsule. The causative nature of these lesions seemed to be confirmed by the patient's freedom from pain subsequent to the removal of the herniations.

Exploration of the painful area in a small series of cases of periarticular fibrositis ("panniculitis") of the menopausal type suggested that a similar mechanism might also be responsible for the pain in these cases.

Physiologic principles underlying certain lines of physical treatment commonly employed in the treatment of fibrositis are shown to be rational for the pathologic conditions described.

Action of Prostigmine on Paralysis Following Cerebral Trauma

N. J. Grashchenkov. In AMERICAN REVIEW OF SOVIET MEDICINE, 4:3:201, February 1947.

The synthetic drug prostigmine, also known as proserine in the USSR, is a member of the atropine-antagonist group, almost identical with the natural alkoloid eserine physostigmine.

Prostigmine is less toxic and has less effect on the cardiovascular system than natural physostigmine. In other respects the effect of the two alkaloids are similar: both increase intestinal peristalsis and increase the muscarine effect of the cholinergic nerves by inhibiting cholinesterase, assuring a larger accumulation of acetylcholine, the basic mediator of vegetative, sensory, and motor nerves. Both alkaloids lower the blood pressure. Prostigmine is injected in doses of 0.5-1.5 mg.

Clinical trial has given successful results with chemical mediators. In 1936 Walker successfully treated myasthenia with prostigmine, avoiding the toxic effects

of physostigmine. The action of prostigmine in myasthenia was explained by deficiency of acetylcholine due to insufficient formation or to excessive destruction of cholinesterase, or by formation of a curare-like substance which paralyzes the myoneural junction. Prostigmine is known to inhibit cholinesterase. In the second explanation, it is assumed to counteract the curare-like substance. At present, the first theory has a greater number of adherents.

Clinical research was conducted for many years with these preparations in the Clinic for Nervous Diseases. In 1939 the clinic began to study the mechanism of action of prostigmine (synthesized by Magidson). At the outset of World War II hospitals were flooded with patients suffering from severe injuries of the nervous system. The therapeutic effect of prostigmine was studied in traumatic paralysis, in 1942 by Ratner in our clinic. Research also was done in the Chelyabinsk branch located in one of the neurologic hospitals. Studies were continued in 1943-44 on the motor and sensory functions of the nervous system and on the thresholds of excitation of different sense organs.

Editor's Summary

Prostigmine was injected one or more times in nearly 300 cases of cerebral trauma with paralysis. In most cases there was immediate and lasting motor and sensory improvement; in some this was striking, and in only 6 per cent of the cases was no improvement observed. The author discusses the possible mechanisms underlying this therapeutic effect, and concludes that prostigmine corrects functional asynapsis—the functional elimination of structurally intact nervous elements exposed to the toxic autolytic products of adjacent destroyed tissue. It is presumed that prostigmine exerts a direct beneficial effect on the altered enzymatic processes in these poisoned tissues, as well as an indirect effect via the vegetative nervous system.

Kinesotherapy and Extension Treatment in Rheumatoid Arthritis

Gunnar Edstrom, D.M., Lecturer in Rheumatology and Physical Medicine and Physician in Charge, Department of Rheumatology, University Hospital, Lund, Sweden. In BRITISH JOURNAL OF PHYSICAL MEDICINE, 10:1:4, January-February 1947.

Rheumatoid (atrophic) arthritis is an infective process of a chronic type. Hyperergic reactions and altered conditions of reactivity, however, are often involved and influence the clinical picture. For instance, we may encounter a hypersensitiveness to mechanical and thermal stimuli. This is of importance for our plan of treatment, not least in kinesotherapy.

Aims and methods of kinesotherapy

The aim in all kinesotherapy for rheumatoid arthritis must therefore be avoidance of all manipulations which are not necessary to preserve the function of the diseased joints. In spite of this, the therapeutic employment of movement is necessary in almost every case of rheumatoid arthritis, because in this disease the fuction of the affected joints invariably demands extremely careful attention. In every case of rheumatoid arthritis it is necessary for the articular function to be regularly controlled from the outset of the disease by a trained medical gymnast. Unfortunately, this prophylactic measure against contractures is rarely adopted, and a rheumatism clinic is daily visited by patients with contractures or defective positions in one or several joints.

From what is said above it is evident that in the kinesotherapy of rheumatoid arthritis the principal em phasis is laid on remedial exercises. Massage, however, ought to be employed to a very limited extent in rheumatoid arthritis. Only in cases of very pronounced muscular atrophy, which are difficult to treat with movements—as in seriously affected cases confined to bed—or in order to facilitate the medical gymnastics by a softening of hard contracted muscles, can massage of the muscles and the tendons be used to some extent, although always with caution and a gentle hand. Never apply massage over the affected joints.

Occupational Therapy and Rehabilitation

A. N. Aitken, Sanatorium Director, Niagara Sanatorium, Lockport, New York. In AMERICAN REVIEW OF TUBERCULOSIS, 55:1:49, January 1947.

Basically a rehabilitation program in a sanatorium is a plan of treatment to counteract the psychosomatic effects of the disease, tuberculosis. It is unfortunate that the term "psychosomatic medicine" had not come into use before the catch-all word "rehabilitation" had become so widely adopted in medical and nonmedical fields. Or rather, if some word had been devised, specifically delineating the treatment of the psychosomatic effects of disease, much confusion and misunderstanding would have been avoided. This is particularly true in the treatment of tuberculosis.

Tuberculosis may produce a wide range of physical handicaps and the patients are subjected to a multitude of emotional disturbances, brought on by a complexity of causative factors, often due to popular misconceptions, false implications and prejudices, handed down through the generations. Many methods have been devised to correct or ameliorate these physical and mental handicaps.

These emotional disturbances begin with the diagnosis of the disease. It is consumption, a thing to be shunned, incurable or leading to a life of uselessness. They are augmented by hospitalization, separation from family and friends, the stigmata of welfare-aid so often needed and all those that go with being a sanatorium inmate. They are exaggerated by our treatment, the necessary emphasis on the communicable nature of the disease and the invalidism which we deliberately develop. Patients become self-conscious, isolated and sensitive, but dependent. They are neurotic, self-centered, selfish, fearful of others, fearful of themselves, fearful of effort. It becomes impressed in them that to keep on living is the only important thing in life. These are disabilities which can be counteracted only by well-timed measures, often devious and unobtrusive, and by constant effort.

Summary

Basically a rehabilitation program in a sanatorium is a plan of treatment to counteract the psychosomatic effects of the disease, tuberculosis. In such a program physical retraining, mental and social readjustment are essential and, as an adjuvant to these, vocational training is valuable. To achieve these results, a variety of facilities are available and many methods can be used. As occupational therapy is any activity prescribed and guided for the purpose of contributing to recovery, any of the methods used in such a program can be incorporated in this line of therapy. This type of program, as it is used at Niagara Sanatorium, is described. The results in reducing hazard to the public, by keeping patients satisfied with sanatorium care and by helping prevent postsanatorium relapse, are presented.

Deconditioning or Rehabilitation—Which?

A. William Reggio, M.D., Boston, Massachusetts. In AMERICAN JOURNAL OF SURGERY, 73:2:219, February 1947.

On May 30, 1941, at the Annual Meeting of the American Association for the Surgery of Trauma, Dr. Robert H. Kennedy of New York said, "We are wasting a tremendous amount of money and manpower by treating a broken bone and letting a well man get sick physically and mentally while under our care. Then after the damage is done, we spend months, years, or a lifetime trying to bring him back to normal."

In discussing the paper Dr. Frank D. Dickson of Kansas City, Missouri, said, "We . . . have been listening to methods of treatment as far as the fracture itself is concerned and we are learning of more and more methods all the time. There is, however, great danger that we will become so preoccupied with the actual setting of the fracture and its local treatment that we will forget . . . about the human being with whom we are dealing."

It was my privilege to be the second discusser and I said, "One trouble is that many of the physicians who want to get their patients back to work do not know how to get them back. They do not know enough about physical therapy or occupational therapy."

Many excellent surgeons have never really seen physical and occupational therapy functioning at their best and as a result do not realize how valuable an adjunct these two can be to their efforts in restoring a casualty to economic usefulness. This is not entirely their fault because there have been many erroneous ideas promulgated regarding the work of both physical and occupational therapists.

Physical therapy is not just a lot of baking and slap dash massage or the turning on of various electric gadgets. It is very different from that and an investigation of the methods and modalities employed will prove instructive.

Occupational therapy likewise is not merely the making of belts and leather pocketbooks. It is a purposeful, functional therapy applied scientifically by trained therapists for the restoration of function.

The blame for not obtaining a good functional result is then placed on the shoulders of physical and occupational therapy instead of where it belongs, on the physician. The age of miracles is not yet past but it is a trifle optimistic to expect them to occur frequently enough so as to cover up inexcusable procrastination.

Industry is well aware of the loss in man-hours and wages as well as the high cost of compensation and is doing much to remedy this. More needs to be done and this Association is in an excellent position to help towards that end. Some remedies are suggested:

1. Start in the medical schools by teaching the basic principles of physical medicine, physical and occupational therapy and rehabilitation.

2. Require surgical internes to serve some time in the physical and occupational therapy departments and acquire a working knowledge of modalities and methods used.

3. Require surgical residents to serve some time in these departments receiving all referees and planning the treatment with the chief therapists, as well as administering therapy.

4. Periodically take up rehabilitation matters at staff conferences and have the staff members occasionally visit the departments while in full swing.

5. Have the chief therapists from the physical and occupational therapy departments make periodic ward rounds with the surgeons and attend staff conferences.

6. Allocate time for papers or discussions on rehabilitation at national, state, and local medical society meetings.

Convalescent Care of the Weakened Shoulder: With Particular Reference to the Use of the Overhead Sling

Robert L. Bennett, M.D., Warm Springs, Georgia. In SOUTHERN MEDICAL JOURNAL, 40:2:120, February 1947.

From the standpoint of functional capacity, that portion which we designate as the "shoulder" or the "shoulder joint" is one of the most important and certainly the most versatile of the body segments. No other segment has such extensive range, in so many planes of motion. Its extreme mobility is accomplished by a complex coordination of muscle groups acting on four major articulations. Because of the complexity of the interplay between these joints and muscles, a clear picture of the mechanics of motion in this segment is difficult to obtain. The excellent descriptions by Codman and Inman offer the greatest assistance. Most of us have a tendency to think of the "shoulder joint" only as the glenohumeral articulation. This leads to inadequate appreciation of shoulder mechanics and the application of incomplete routines in correcting muscular weakness in any one or all of the shoulder girdle muscles.

Weakness in the muscles of the shoulder girdle results from central and peripheral nerve lesions, as well as from traumatic lesions about the shoulder that result in disuse and limited mobility. Therefore, in consideration of the causes of muscular weakness of the shoulder, we must not think only in terms of acute anterior poliomyelitis, polyneuritis, Erb's palsy, brachial plexus injuries, and other purely motor nerve problems, but also realize that fractures, dislocations, contusions, sprains, bursitis, tendonitis, fibrositis, scalenus anticus syndrome, and other local bony and soft tissue lesions can result in severe weakness.

Conclusions

A program for the care of the weakened shoulder girdle group of muscles has been outlined. Particular emphasis was made of the value of early passive motion through normal planes of movement, the absolute necessity of demanding coordinate patterns of motion, and the use of the overhead sling.

Compound Injuries of the Knee Joint: Study 1—Treatment of Noninfected Knee Joints

Joe M. Parker, M.D., and John J. Modlin, M.D., St. Louis, Mo. In ANNALS OF SURGERY, 125:3:341, March 1947.

The keynotes in the aftercare of clean wounds of the knee are: First, the initiation of proper exercises as early as the first day after secondary suture of the skin to prevent quadriceps atrophy; and, second, the early mobilization of the joint to prevent the formation of adhesions that would restrict the range of motion. The latter is very important where the synovium has been destroyed at its lateral and medial reflections. For these reasons, the thoroughness of the initial care, aimed at preventing suppuration and smoothing articular defects, is probably the one most important phase in the proper care of compound injuries of the knee. It is only in those knee joints that have been properly cared for in Evacuation Hospitals that early motion can be instituted.

Disability Resulting from Injuries to Peripheral Nerves

James S. Ellis, M.Chir., F.R.C.S. Lately Orthopaedic Surgeon, Park Prewett E.M.S. Hospital, Basingstoke, Hampshire. In BRITISH JOURNAL OF PHYSICAL MEDICINE, 10:1:2, January-February 1947.

In wartime, injuries to peripheral nerves are common and produce a great deal of disablement. In few branches of traumatic surgery does treatment so greatly influence the man's ability to earn his living. It is of the greatest importance that throughout the long period of treatment usually necessary the surgeon shall look ahead to the patient's future employment, bearing in mind the special factors concerned in each individual case.

Conclusions

In this paper an attempt has been made to show that severe injuries to the major nerves of the limbs do not necessarily bar the patient from useful work. Treatment can go a long way towards lessening the ultimate disability. The patient's intelligent cooperation and interest can prevent the long and tedious waiting from becoming insufferable. Appreciation by the employer of a man's disabilities, as well as of his abilities, is essential if the wounded man is to regain a useful and profitable life. Throughout the whole time, from wounding to resettlement in industry, patient, surgeon and employer must together ensure the satisfactory result which is possible in the majority of these cases.

Book Reviews

Textbook of Anatomy and Physiology. *By Catherine Parker Anthony, B.A., R.N., Instructor of Anatomy and Physiology, Lutheran Hospital, Cleveland, Ohio; formerly Instructor of Anatomy and Physiology, St. Luke's Hospital, and Assistant Instructor of Anatomy and Physiology, Frances Payne Bolton School of Nursing, Western Reserve University. Second edition. Cloth. Price, $3.75. Pp. 542, with 184 illustrations. The C. V. Mosby Company, 3207 Washington Blvd., St. Louis 3, Mo., 1946.*

This edition differs from the first mainly in the amount of physiology included. A great many physiological facts and explanations have been added as well as some additional anatomical facts. The plan of presenting the material with numerous devices for shortening and facilitating the students learning process remains essentially the same as in the first edition. Outline surveys and vocabulary lists appear at the beginning of each chapter, numerous tables and charts are given and outline summaries and review questions are at the end of each chapter. Suggested readings suitable as reference material are also included for each chapter.

This book is highly recommended to nurses training schools as a textbook of anatomy and physiology which will give these subjects an aura of interest and make the study fascinating instead of merely fatiguing.

Annual Review of Physiology. *James Murray Luck, Editor, Stanford University; Victor E. Hall, Associate Editor, Stanford University. Volume IX. Cloth. Price, $6.00. Pp. 736. Published by American Physiological Society and Annual Reviews, Inc., Stanford University, Calif., 1947.*

Again this yearly volume has made its most welcome appearance. It was founded for the purpose of making available to the scientific world a survey of the significant developments in physiology coming from the efforts of workers of all nations. With the end of the war its international character reasserts itself. The present volume has contributions from Great Britain, New Zealand, Belgium, Denmark and Switzerland. A good deal of physiological work kept from publication because of "security" regulations is reviewed for the first time. Each chapter is written by a man of preeminence in his particular field.

Of special interest and significance to physical therapists are the chapters on "Muscle" by Buchthal, "Exercise" by Karpovich, the "Peripheral Circulation" by Carl J. Wiggers, the "Physiological Effects of Heat and Cold" by Gagge and Herrington, "Nerve and Synaptic Conduction" by Bremer, "Bioelectric Potentials in the Nervous System and in Muscle" by Grundfest. These are only a few of the chapters that should have a special appeal for those engaged in physical medicine. One gets the very latest work both experimental and clinical presented and discussed by an outstanding investigator. It is one of the most economical investments possible for the library of those who wish to keep in the fore front of new developments.

The Head, Neck and Trunk Muscles and Motor Points. *By Daniel P. Quiring, Ph.D., Head of the Anatomy Division, Cleveland Clinic Foundation and Associate Professor of Biology, Western Reserve University, Cleveland, Ohio. Cloth. Price, $2.75. Pp. 115, with 103 illustrations. Lea & Febiger, 600 Washington Square, Philadelphia, Pa., 1947.*

The author has previously given us "The Extremities." As in that book this volume also portrays in diagrams and condensed descriptions the straited muscles of the head, neck and trunk. It gives an exact account of the skeletal attachments, nerve and chief arterial supply and functions of these muscles. The muscles of the left side are shown throughout and their Latin names are employed as in Gray's "Anatomy."

This book is highly recommended to physical therapists as the presentation has the advantage of clarity since with few exceptions, each muscle is shown in a single diagram together with its concise description. The line drawings are clear and excellent. Since the trunk and deeper neck muscles do not lend themselves readily to accurate electrical testing, only the general motor points of the face are shown in a single figure. This book gives a rapid and accurate survey of skeletal-muscular anatomy of the regions indicated in its title.

Textbook for Psychiatric Attendants. *By Laura W. Fitzsimmons, R.N., B.S., M.A. Cloth. Price, $3.50. Pp. 332. The Macmillan Company, 60 Fifth Avenue, New York 11, N. Y., 1947.*

The author has attempted to produce a book to contain the fundamental information required by the psychiatric attendant. It is written in simple terms that any intelligent layman would have no difficulty in understanding. It deals with the various aspects of contact with the patient, considering such matters as misconceptions of mental disease, proper nourishment and protection of mental patients, and so on. The material is laid out under definite headings for ready reference. There is no attempt to discuss disease syndromes but discussion of treatment centers around the dominant symptom, such as excitement, depression, convalescence, senility, etc. There is a useful glossary and bibliography. It should prove to be a useful book not only for attendants but for the "breaking in" of nurses on psychiatric wards.

The Treatment of Diabetes Mellitus. *By Elliott P. Joslin, A.M., M.D., Sc.D., Clinical Professor of Medicine Emeritus, Harvard Medical School; Medical Director, Baker Clinic, New England Deaconess Hospital; Howard F. Root, M.D., Associate in Medicine, Harvard Medical School; Priscilla White, M.D., Instructor in Pediatrics, Tufts College Medical School; Alexander Marble, A.M., M.D., Instructor in Medicine, Harvard Medical School, and C. Cabell Bailey, M.D., Research Fellow in Medicine, Harvard Medical School. Eighth edition. Cloth. Pp. 861, with illustrations. Price, $10. Lea & Febiger, Washington Square, Philadelphia 6, Pa., 1946.*

This book presents the experience of its authors in the treatment of more than 29,000 diabetics and glycosurics during a period of over forty-eight years.

It is a valuable reference book for the physical therapist. For instance, there is a section on "Exercise in Treatment of Diabetes." It also discusses athletics in the etiology of diabetics; bed exercises for surgical patients; the favoring effect of exercise upon the utilization of carbohydrates, and the lowering of blood sugar; Buerger's passive exercises; effect of exercise on carbohydrate tolerance; exercise in the management of juvenile diabetes; massage and exercise in the treatment of constipation in this disease; the significant changes in the electrocardiogram as evidenced by a lowering of the T-wave in exercising patients with hypoglycemia; exercise for feet in this disease; exercises in the treatment of gangrene; insulin promotes the formation of glycogen in the recovery of muscular exercise; hospital cases suffering from lack of exercise even though a gymnasium is theoretically available for them; unusual or strenuous exercise by its demand for sources of energy may precipitate hypoglycemia; the "insulin reaction" which may follow unusual or strenuous exercise in the well-controlled diabetic, and light treatments.

It is estimated that there are a million diabetics in the United States today. Their life expectancy has increased from forty-four years to sixty-four, thus exposing them to all the vicissitudes which nondiabetics must meet. This has brought with it a multitude of complications in the cardiovascular, renal, nervous system, and the eyes. This has necessitated the collaboration of the specialists who have joined the senior author in the preparation of this new edition.

This study is of great value to the general practitioner because it presents the simple methods which he can use with success in office cases; it describes the plan followed with ambulatory cases cared for in a nursing home, and it reports the experience with those patients, who, because of complications, require investigation and treatment under hospital conditions.

Handbook of Diet Therapy. *Written and compiled for the American Dietetic Association by Dorothea F. Turner. Cloth. Pp. 112. Price, $2. The University of Chicago Press, 5750 Ellis Ave., Chicago 37, Illinois, 1946.*

This book gives fourfold emphasis to the modern trends in diet therapy: first, in terms of a reevaluation of the therapeutic diet to meet the requirements of the individual patients; second, in presenting a simplified method for planning the therapeutic diet; third, in a clarification of dietetic terminology, and fourth, in presenting the need for a more realistic consideration of the patient. The simplification, clarity and common sense of the material found in this handbook are most valuable because the field of diet therapy has been flooded with a variety of diets in controversial terminology.

The author is Assistant Professor of Medicine at the University of Chicago. She has been chairman of the Diet Therapy Section of the American Dietetic Association and editor of its journal. This book is recommended to physicians, nurses and dietitians.

Applications of Germicidal, Erythemal and Infra-red Energy. *By Matthew Luckiesh, D.Sc., D.E., Director, Lighting Research Laboratory, General Electric Company, Nela Park, Cleveland. Cloth. Price, $5.50. Pp. 463, with 161 illustrations. D. Van Nostrand Company, Inc., 250 Fourth Ave., New York 3, N. Y., 1946.*

The author of this work is one of the foremost scientists in the field of ultraviolet and infra-red radiation. The present volume therefore should prove of great value to everyone who is interested in, or uses, either form of energy. The first 10 pages are devoted to challenging the sun, sunlight and skylight, erythema and tan, units and terminology for biological effectiveness. The units suggested for dosage will be strange to the clinician but it is time that we at least have some common unit of a given magnitude. This particular section should be read and carefully digested by anyone using these potent agents. The next 10 pages discuss very ably germicidal energy. This section is important to those connected with schools, hospitals, theaters because of the emphasis that is being placed on cutting down infection by use of the germicidal wave band 2537 A°. This lamp has been popularly designated as "cold quartz."

The remainder of the book is devoted to sources of artificial ultraviolet for the home and this will prove of great interest to most people.

The book is well written, profusely illustrated and should be in the library not only of physical therapists, physiatrists, but also anyone in the field of medicine. While scientific in character it is presented in simple understandable language. There is a list of 124 references. The author gives an excellent discussion of the new high pressure capillary tube for ultraviolet radiation. This new type of lamp has not yet had a clinical trial and might prove of real clinical value.

The Second Forty Years. *By Edward J. Stieglitz, M.S., M.D., F.A.C.P. Foreword by Anton J. Carlson, A.M., Ph.D., LL.D., M.D., Sc.D. Cloth. Pp. 317. Price, $2.95. J. B. Lippincott Company, East Washington Square, Philadelphia 5, Pa., 1946.*

This is a straightforward, popular presentation of the scientific facts about the second half of your life. Doctor Carlson, in his foreword, expresses the objects of this book as follows: "The fundamental biologic processes of growing old and the gradual impairments and infirmities which follow are as inevitable and unavoidable as the wearing out of one's shoes by continued use. But biology and medicine have already shown that better hygiene, better medical guidance, and living in accordance with today's understanding of the nature of man will delay the time of onset and decrease the severity of these impairments, thus increasing the years of possible service and happiness of the aging citizen. This knowledge, confined to biologists and physicians, will have little influence on our ways of life. It must become the common knowledge of every adult man and woman. 'The Second Forty Years' is written to aid this achievement."

This book is a guide to longer life, and it explodes myths and superstitions that surround the process of growing older. It points out that the main difference between an elderly person and a youth is that the elderly person must strive a little harder and use more judgment in order to maintain a healthy mind and body. It is a must book for all men and women past forty.

Outline of the Spinal Nerves. *By John Favill, A.B., M.D., F.A.C.P., Clinical Professor of Neurology (Rush), University of Illinois College of Medicine, Attending Neuropsychiatrist, Presbyterian Hospital, Chicago. Cloth. Price $3.75. Pp. 191. Charles C. Thomas, Springfield, Illinois, 1946.*

This book gives full information on motor functions and neurologic aspects of movement. Data concerning root, nerve, muscle and movement is presented in convenient table form. The muscles are numbered throughout the text in order of their appearance under root origins, from above downward. This is convenient if it is desired to refer quickly from one list to another. However, an alphabetical list is included for the reader who wishes to quickly refer to a particular muscle.

Origins and insertions of muscles are given in form which is abbreviated but still is sufficient for orientation and identification and to refresh the memory as to mechanisms. Some order is brought out of the chaos of the usually forgotten back muscles.

This "Outline of the Spinal Nerves" provides a key that will be useful to every physical therapist.

Medical Research: A Symposium. *Edited by Austin Smith, M.D. Cloth. Price, $5. Pp. 169, with 17 illustrations, including 10 subjects in color. J. B. Lippincott Company, East Washington Square, Philadelphia 5, Pa., 1946.*

This book is a collection of articles which provides answers to the questions on medical research. The first article is by Dr. Torald Sollmann, Dean Emeritus of Western Reserve University School of Medicine on "Fundamentals of Medical Research." The editor and secretary of the Council on Pharmacy and Chemistry next discuss "Some Practical Aspects of Research." The late Dr. Herbert O. Calvery of the Food and Drug Administration, Federal Security Agency, then describes the "Laboratory;" "The Manufacture and Development of New Drugs" is discussed by S. De Witt Clough, Chairman of the Board of Abbott Laboratories; Eldon M. Boyd, M.D., Professor and Head of the Division of Pharmacology, Queens University Medical School then reviews "Medical Research in the University Medical School;" Dr. Walter Alvarez of the Mayo Clinic then describes "Clinical Research."

Dr. Morris Fishbein has a chapter on "The Publicizing of Scientific Research." Dr. Milton G. Bohrod, Pathologist and Director of Laboratories, Rochester General Hospital, and H. Lou Gibson, Technical Editor, Medical Division, Eastman Kodak Company, discuss in the last chapter "Photography in Medical Research." This symposium should be read by all medical researchers.

The Practice of Physical Medicine. *By Heinrich F. Wolf, M.D., Consultant, Department of Physical Therapy, Mount Sinai Hospital, formerly Director of the Department of Physical Therapy, Central Neurological Hospital, Welfare Island, New York. Cloth. Price, $5. Pp. 322, with 53 illustrations. Wilcox & Follett Company, 1255 S. Wabash Ave., Chicago 5, Illinois, 1947.*

The announcement of this book states: "These pages, written by Dr. Heinrich F. Wolf, give the answer to the problems and questions of those practitioners who will want not only to use physical medicine procedures but also to employ a truly reliable guide in this fascinating field." It is questionable whether this book forms a "truly reliable guide." The following quotations are some of the reasons for this doubt: "Miley reports excellent results in the treatment of thrombophlebitis in septicemia caused by hemolytic staphylococcus aureus and particularly in severe, bulbar poliomyelitis. He also reports good results in intractable bronchial asthma and acute articular rheumatism." The Council on Physical Medicine of the American Medical Association has not accepted the apparatus about which Miley speaks—the hemoirradiator. In speaking of the clinical application of galvanic current the author gives a method of treating internal hemorrhoids. In discussing osteomyelitis it is stated: "Short wave diathermy in small doses, however, has a very good effect, though the reports in the literature are somewhat contradictory." "It is difficult to select just the right amount of energy, particularly because the various forms of applications, air-spaced electrodes, cuff electrodes, etc., have such a different heating effect within the body. Dosimetry will remedy the situation." "In hemiplegia mild short waves through the head will remove the edema due to regenerative inflammation around the lesion, ease the pressure around the uninjured nerve fibers and reestablish their function." In speaking of poliomyelitis it is stated: "The author has applied long wave diathermy to the spine in cases up to 20 years after the initial attack, and obtained definite improvement in the function of muscles. The electrodes have to be placed over the affected segments. As the intensity of the current is high, 1500 to 2000 milliamperes, only the technic with padded electrodes is practicable." Under tonsillitis it is stated: "At present, short wave diathermy (applied by air-spaced electrodes) is very useful."

These are random statements selected from this volume, and it is believed that these prevent this book from being a reliable guide to physical medicine.

The Psychoanalytic Theory of Neurosis. *By O. Fenichel, M.D. Cloth. Price, $8.50. Pp. 703. W. W. Norton & Co., Inc., 101 Fifth Avenue, New York 3, N. Y., 1945.*

Although the psychoanalytic literature is deluged with a profusion of supposedly valuable contributions it is a rarity to come across anything which approaches the basic value of Doctor Fenichel's book. It may be considered an encyclopedia of psychoanalysis since it is one of the best documented and carefully composed works of such proportion that has come into print. The original contributors are amply recognized. The bibliography alone is a proud accomplishment and greatly increases the value of the book. The author's style is free and his use of simple English excellent, even in such a field where the language itself can be very confusing. The material is highly technical and consequently at times the issues he discusses must become a little obscure for anyone without a good indoctrination in psychoanalysis. However, no one else would be interested in or able to read such a book so the author admittedly is directing his words to a highly selected group.

The plan of the book is very comprehensive. The first section deals with preliminary considerations of the basic point of view and method in part 1, and in part 2 there is an exhaustive discussion of mental development from the earliest stages through to puberty. The second and larger section deals more directly with clinical entities and the theory of their construction. All the usual groups of cases are covered. The final two chapters on the clinical course of neuroses and on therapy and prophylaxis of neuroses are brief and valuable expositions of the present status of therapy and its potentialities.

It would be futile to try to review in detail the material in this magnificent contribution because it would consume too much space. Suffice it to say that the whole tone of the book is so sound and well presented that it may be highly recommended to those people actively engaged in the psychiatric treatment of neurotic patients.

Meet Our Contributors

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Hansen, Ruth, Orthopaedic Hospital, 2400 S. Flower St., Los Angeles 7, Calif. Miss Hansen attended the Sargent School of Physical Education in Boston, and the University of Oregon from which she received her B.S. degree in 1932. She was employed at the Newington Home for Crippled Children, Newington, Conn., 1935-36; Babbitt Hospital, Vineland, N. J., 1936-42; A. Harry Moore School, Jersey City, N. J., 1942-43, and worked with cerebral palsy patients for the Montana State Board of Health in 1945. At present she is a graduate student at the University of Southern California, and is doing cerebral palsy work at Orthopaedic Hospital. Member: American Physiotherapy Association.

Jacobs, Julian E., 121 West 7th St., Charlotte 2, N. C. Doctor Jacobs received his M.D. degree from the University of Nebraska in 1935. He served as Chief of Orthopedic Section and Physical Therapy, Lawson General Hospital, Atlanta, Ga., in 1946. At present he is Associate Surgeon, N. C. Orthopedic Hospital, Charlotte, N. C. Member: American Medical Association; Honorary member, British Orthopedic Association; Fellow, American Academy Orthopedic Surgery; Diplomate, American Board of Orthopedic Surgery; Fellow, American College Surgeons.

Kendall, Florence P. (Mrs. Henry O.), 3 Englewood Road, Baltimore 10, Md. Mrs. Kendall received her B.S. degree from the University of Minnesota in 1930, and her certificate of physical therapy from Walter Reed General Hospital in 1932. She served as a physical therapy aide, Walter Reed General Hospital from 1932-33; physical therapist, Children's Hospital School, Baltimore, Md., at intervals from 1933 to present, and as supervisor of physical therapy, Maryland State Department of Health from 1936-1944. Member: American Physiotherapy Association, American Registry of Physical Therapy Technicians.

Kendall, Henry O., 3 Englewood Road, Baltimore 10, Md. Mr. Kendall attended the Evergreen School for the Blind, Baltimore, Md., and received his certificate of physical therapy in June 1920. He has served at the Children's Hospital School, Baltimore, from June 1920 to the present time and is now director of the School, and has been supervisor of physical therapy, Division of Special Education, Baltimore School Board from 1932 to date. Member: American Physiotherapy Association, American Registry of Physical Therapy Technicians.

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Lowman, Charles LeRoy, 2417 S. Hope St., Los Angeles 7, Calif. Doctor Lowman received his M.D. degree from the University of Southern California in 1907, and an Honorary D.Sc. degree from Knox College in 1937. Besides his medical positions held, Doctor Lowman has served on the Advisory Committee of the American Physiotherapy Association; Advisory Committee, Southern California Chapter, American Physiotherapy Association; lecturer in physical therapy, University of Southern California; lecturer in physical therapy, summer school, University of Southern California; consultant, University of Southern California Health Service, Department of Physical Education; consultant in orthopedics, Los Angeles City School Health Service. Member: American Orthopedic Society; American Academy of Orthopedic Surgery; American Academy of Physical Education; Western Orthopedic Society; Los Angeles Orthopedic Society; American Medical Association; California State Medical Association; Los Angeles County Medical Society; Honorary Member, Mexico Academy of Arts and Sciences.

St. James, Robertine, 2810 Maryland Ave., Baltimore, Md. Miss St. James received her certificate from Bouve-Boston School of Physical Education in 1933, attended Boston University in 1934, and received her certificate of physical therapy from Harvard Medical School in 1941. She also attended the Children's Rehabilitation Institute for a three-month course in 1932. She was employed by Mary Free Bed Convalescent Home and Orthopedic Center, Grand Rapids, Mich., 1941-1942, and at the State Hospital for Crippled Children, Elizabethtown, Pa., 1942-46. At present she is employed as director of physical therapy, The Children's Rehabilitation Institute, Inc., Cockeysville, Md. Member: American Physiotherapy Association, American Registry of Physical Therapy Technicians.

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